AD-A262 722

Technical Report TRAC-TR-0292
January 1992

Air Ground Motorized Cavalry Evaluation

Final Report

TRADOC Analysis Command-Operations Analysis Center
Combined Arms Analysis Directorate
Fort Leavenworth, Kansas 66027-5200

Distribution Statement: Approved for public release; distribution is unlimited

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AIR GROUND MOTORIZED CAVALRY EVALUATION

FINAL REPORT

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REPORT DOCUMENTATION PAGE	Form Approved OMB No 0704-0188

1. AGENCY USE ONLY *(Leave blank)*

2. REPORT DATE

3. REPORT TYPE AND DATES COVERED
Final November 1990-January 1992

4. TITLE AND SUBTITLE
Air Ground Motorized Cavalry (AGMC) Evaluation

5. FUNDING NUMBERS

6. AUTHOR(S)
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8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Combined Arms Command-Combat Developments
Force Design Directorate
ATTN: ATZL-CDF
Fort Leavenworth, KS 66027

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*
The Air Ground Motorized Cavalry (AGMC) Evaluation was a study conducted by the Combined Arms Analysis Directorate of the Training and Doctrine Command (TRADOC) Analysis Command. This document is the final report for the AGMC evaluation.

The AGMC evaluation began with a tasking from the TRADOC Commander reflecting a desire to evaluate several corps-level reconnaissance and security forces. Three TRADOC schools (Armor, Infantry, and Aviation) were tasked to design, from their perspective, an appropriate brigade/regiment to conduct these missions. The AGMC evaluation provided analytic insights into the strengths and weaknesses of each proponent school design.

14. SUBJECT TERMS

15. NUMBER OF PAGES
270

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UNLIMITED

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. Z39-18
298-102

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CONTENTS

* Published under separate cover

FIGURES

TABLES

GLOSSARY

AALPS	automated air load planning systems
AAWS-M	advanced antiarmor weapon system-medium
ACDB	aircraft data base
ACR	armored cavalry regiment
ADDS	Army data distribution system
AFAS-C	advanced field artillery system-cannon
AGMC	Air Ground Motorized Cavalry
AGS	armored gun system
AIRCR	air cavalry regiment
ALB	AirLand Battle
ALB-F	AirLand Battle-Future
ALO	AirLand Operations
ALOC	air line of communication
ALP	automatic load planner
ALP-LM	automatic load planner-loading module
ALP-UI	automatic load planner-user interface
AMC	Army Materiel Command
AMMDB	annual maintenance manhour data base
AMMH	annual maintenance manhour
AMS-H	antiarmor missile system (heavy)
AOE	Army of Excellence
AR	Army Regulation
ASL	authorized stockage list
ASM	armored systems modernization
ATACMS	Army tactical missile system
ATLAS	a tactical, logistical, and air simulation model
AVIM	aviation intermediate maintenance
AVUM	aviation unit maintenance
BAI	battlefield air interdiction
BCE	baseline cost estimates
BMP	Russian fighting vehicle
C2	command and control
CAA	U.S. Army Concepts Analysis Agency, Bethesda, MD
CAC-CD	Combined Arms Command-Combat Developments
CASCOM	Combined Arms Support Command
CEM	concepts evaluation model
COEA	cost and operational effectiveness analysis
COMMZ	communication zone
CONUS	Continental United States
CORBAN	corps battle analyzer
CS	combat support
CSS	combat service support
CTA	common table allowances

DA	Department of Army
DARPA	Defense Advanced Research Projects Agency
DCSLOG	Deputy Chief of Staff for Logistics
DCSOPS	Deputy Chief of Staff for Operations
DoD	Department of Defense
DS	direct support
EEA	essential element of analysis
EFCDB	exportable force cost data base
ELF	enter list file
EUR	Europe
FA	field artillery
FARP	forward area refueling point
FASTALS	Force Analysis Simulation of Theater Administration and Logistics Support
FCM	force cost model
FEBA	forward edge of battle area
FMTV	family of medium tactical vehicles
FOREWON	force and weapons system
FORTRAN	formula translation
FSB	forward support battalion
FSV(C)	future scout vehicle-cavalry
FSV(S)	future scout vehicle-scout
FY	fiscal year
GAL	gallons
GS	general support
HEMTT	heavy expanded mobility tactical truck
HET	heavy equipment transporter
HF	Hellfire
HMMWV	high-mobility multipurpose wheeled vehicle
HRS	high-resolution scenario
HUMINT	human intelligence
HV-LB	HMMWV-Longbow
IPR	in-progress review
ITEMDB	item data base
Janus	simulation model
JSPD	joint strategic planning document
km	kilometer
LATAM	Latin America
LB	Longbow
LCCE	life cycle cost estimates
LCR	light cavalry regiment
LH	light helicopter
LH-LB	light helicopter equipped with longbow technology
LIA	logistics impact analysis
LIN	line item number

LM	loading module
LOGCEN	U.S. Army Logistics Center, Fort Lee, VA
LOTS	logistics over-the-shore
LPFDS	logistics planning factor data system
LR	logical regions
LRS	low-resolution scenario
MAC	Military Airlift Command
MACLO	Military Airlift Command Liaison Office
MACOM	major Army commands
MACR	modernized armored cavalry regiment
MAPEX	map exercise
MARC	Army manpower requirements criteria
MI	Military Intelligence
MIB	motorized infantry brigade
MIDAS	Modular Information Data Access System
MLRS	multiple-launch rocket system
mm	millimeter
MOE	measure of effectiveness
MOS	military occupational specialty
MPA	military pay and allowances
ODCSOPS	Office, Deputy Chief of Staff for Military Operations
OPTEMPO	operational tempo
P90E	European programming rates for FY90
P91M	Mideast programming rates for FY91
PAX	passenger
PLL	prescribed load list
POL	petroleum, oil, and lubricants
POM	Program Objective Memorandum
POMCUS	prepositioned organizational materiel configured to unit sets
PWRMS	prepositioned war reserve materiel stocks
RCZ	rear combat zone
ROC	required operational capability
SER	system exchange ratio
SGA	standards of grade authorizations
SP	self-propelled
SRC	standard requirements code
STAFF	smart target activated fire and forget
STON	short ton
SWA	Southwest Asia
TAA	total Army analysis
TAFCS	The Army Force Cost System
TGW	terminally guided weapon
TLE	typeload editor

TOE	tables of organization and equipment
TRAC-LEE	TRADOC Analysis Command-Fort Lee, VA
TRAC-OAC	TRADOC Analysis Command-Operations Analysis Center, Fort Leavenworth, KS
TRAC-SWC	TRADOC Analysis Command-Scenario and Wargaming Center, Fort Leavenworth, KS
TRAC-TOD	TRADOC Analysis Command-TRAC Operations Directorate, Fort Leavenworth, KS
TRAC-WSMR	TRADOC Analysis Command-White Sands Missile Range, NM
TRADOC	Training and Doctrine Command
TRANSMO	transportation model
TRASANA	U.S. Army TRADOC Systems Analysis Activity
UI	user interface
URS	unit requirements sheet
VIC	Vector-in-Commander
vs	versus
WARF	wartime replacement factor

ABSTRACT

The Air Ground Motorized Cavalry (AGMC) Evaluation study was conducted by the Combined Arms Analysis Directorate of the Training and Doctrine Command Analysis Command. This document is the final report for the AGMC evaluation.

The AGMC evaluation began with a tasking from the TRADOC Commander reflecting a desire to evaluate several corps-level reconnaissance and security forces. Three TRADOC schools (Armor, Infantry, and Aviation) were tasked to design, from their perspective, an appropriate brigade/regiment to conduct these missions. The AGMC evaluation provided analytic insights into the strengths and weaknesses of each proponent school design.

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AIR GROUND MOTORIZED CAVALRY EVALUATION

EXECUTIVE SUMMARY

1. Purpose. To evaluate the different force designs for strengths and weaknesses using the parameters and missions stated in the December 1990 CAC-CD memorandum.

2. Introduction.

a. During a General Officer Southwest Asia (SWA) map exercise (MAPEX) conducted at Fort Leavenworth on 2-3 July 1990, the TRADOC Commander tasked the Commandants of the Armor, Aviation, and Infantry schools to each develop, from their perspective, a corps-level reconnaissance and security force for contingency operations. Specifically, the Armor school was to develop a light cavalry regiment (LCR); the Aviation school an air cavalry regiment (AIRCR); and the Infantry school a motorized infantry brigade (MIB) modeled after the 9th Infantry Division. He also tasked the Combined Arms Command-Combat Developments (CAC-CD) Commander to evaluate the different force designs.

b. In a July 1990 message, CAC-CD provided design guidance to each of the proponent schools. It included the need to develop a brigade/regimental sized organization for the 2004 time frame to perform forward and flank reconnaissance, surveillance, security, and screening missions. The guidance also included the following design parameters for the organization:

(1) The organization must have global utility.

(2) The organization, to include sustainment, must be rapidly deployable (air).

(3) The organization must be self-contained, that is, capable of performing its own direct support (DS) supply and maintenance.

(4) The organization must be packagable, that is, capable of being task organized into self-sustaining entities of less than brigade size.

(5) The corps will provide command and control (C2), as well as backup DS and general support (GS) to the organization. The organization may expect to operate with and receive augmentation from corps or other theater forces.

(6) The organization will be 100 percent mobile with organic resources. It must have good off-road tactical mobility.

(7) The organization will be capable of 24-hour operations under all weather conditions.

(8) The organization will be capable of bringing long-range artillery and air fires to bear on known or suspected enemy locations.

(9) The organization will be capable of providing human intelligence (HUMINT) verification of intelligence developed by technological means.

(10) The organization must be able to operate over extended ranges.

(11) The organization will be capable of operating across the total spectrum of combat from low-to-high intensity.

c. In a December 1990 memorandum, CAC-CD requested analytical support from the TRADOC Analysis Command-Operations Analysis Center (TRAC-OAC) for selected missions and parameters which were readily quantifiable. CAC-CD planned to use TRAC-OAC's quantifiable results as part of their overall evaluation of the different force designs. The specific issues which were tasked and which provided the basis for the Air Ground Motorized Cavalry (AGMC) evaluation are listed below:

(1) Determine the number of sorties required to air deploy each of the force designs.

(2) Determine the required short tons (STON)/gallons of classes III and V for each of the force designs (daily rate and 30-day total). Additionally, determine the number of sorties required to resupply each of the force designs with classes III and V.

(3) Determine the force costs for each design. (Note: CAC-CD added this parameter after the July 1990 message was sent.)

(4) Determine if each of the force designs are 100 percent mobile with organic resources.

(5) Evaluate the ability of each of the force designs to accomplish the following missions.

(a) Surveillance.

(b) Screen.

(c) Guard.

(d) Covering force. (Note: CAC-CD deleted this mission from the evaluation during January 1991.)

(6) During the mission evaluations, determine the following:

(a) The ability of the force designs to bring long-range artillery and air fires to bear on known or suspected enemy locations.

(b) The ability of the force designs to provide HUMINT verification of intelligence developed by technological means.

(c) The ability of the force designs to operate at extended ranges.

d. CAC-CD's December 1990 memorandum also stated the following priorities for the scenarios to be used in the evaluation.

(1) Southwest Asia.

(2) Latin America (LATAM).

(3) Europe (EUR).

3. Discussion.

a. *Background.*

(1) CAC-CD determined that the base case force structure for this study would be the armored cavalry regiment (ACR) objective Army of Excellence (AOE). In April 1991, the CAC Commander requested that the ACR, modernized with 2004 equipment, be considered as an alternative in the analysis. These organizational structures are provided in figures 1 and 5, respectively.

(2) Each proponent school developed their own force design. The organizational structures for these designs are provided in figures 2 through 4.

(3) The proponent schools were actively involved in all phases of the study.

(a) The schools reviewed and made comments on the AGMC Analytical Support Plan found in appendix A. They also assisted in the development of the success criteria.

(b) Starting 10 January 1991, the schools participated in numerous in progress reviews (IPRs). During the IPRs, the schools were able to review and comment on proposed analysis and review analytical results as they became available.

(c) Each school determined how their respective force would fight in each of the scenarios. The schools determined the initial deployment locations, developed the scheme of maneuver, and assisted in the development of the tactical decision rules.

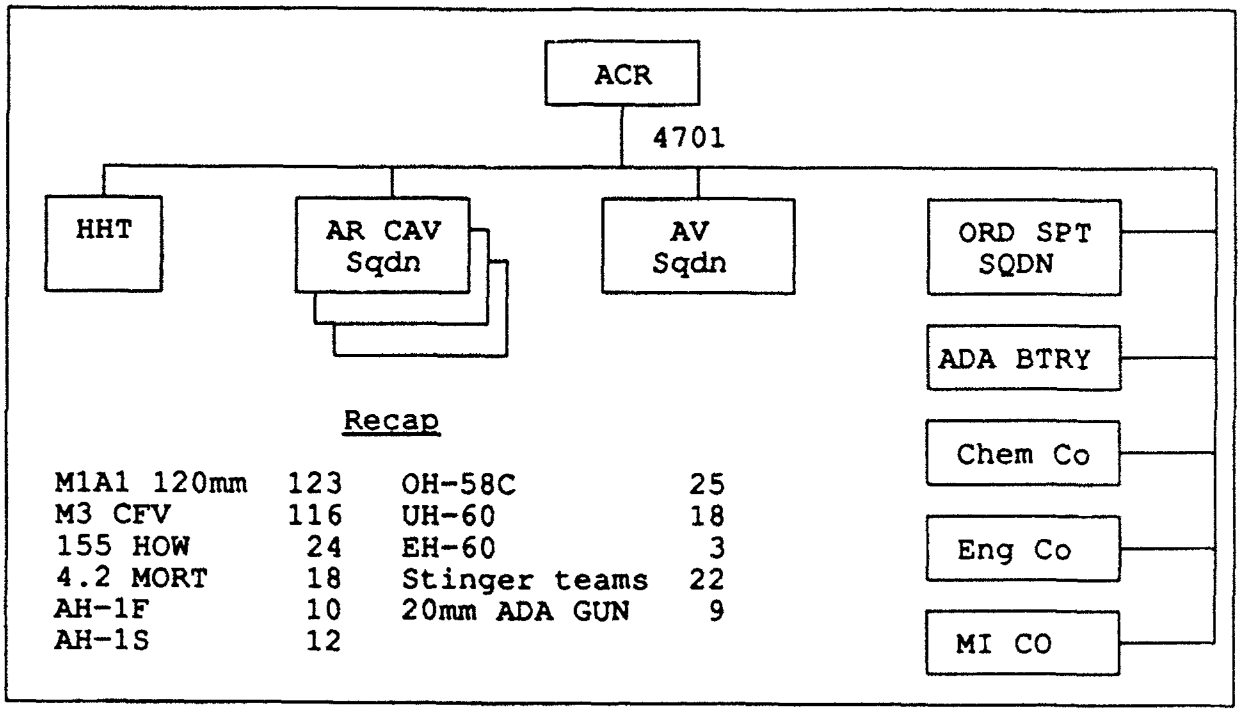

Figure 1. ACR base case objective AOE

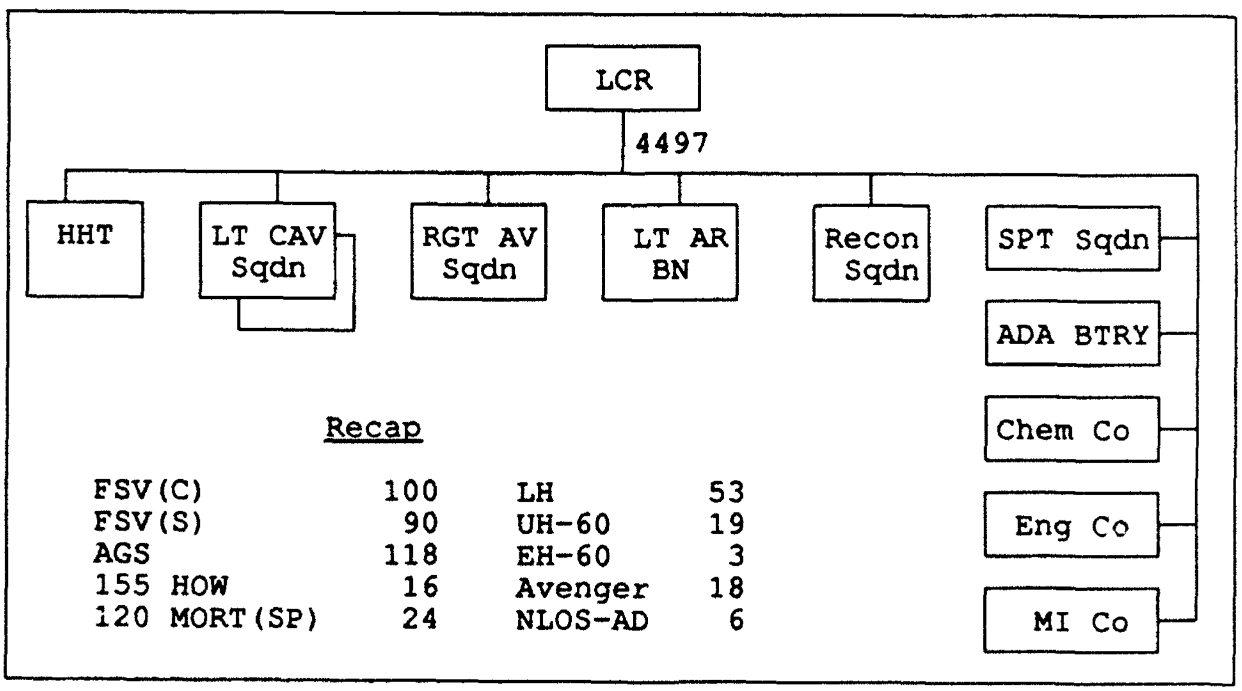

Figure 2. LCR (Armor school design)

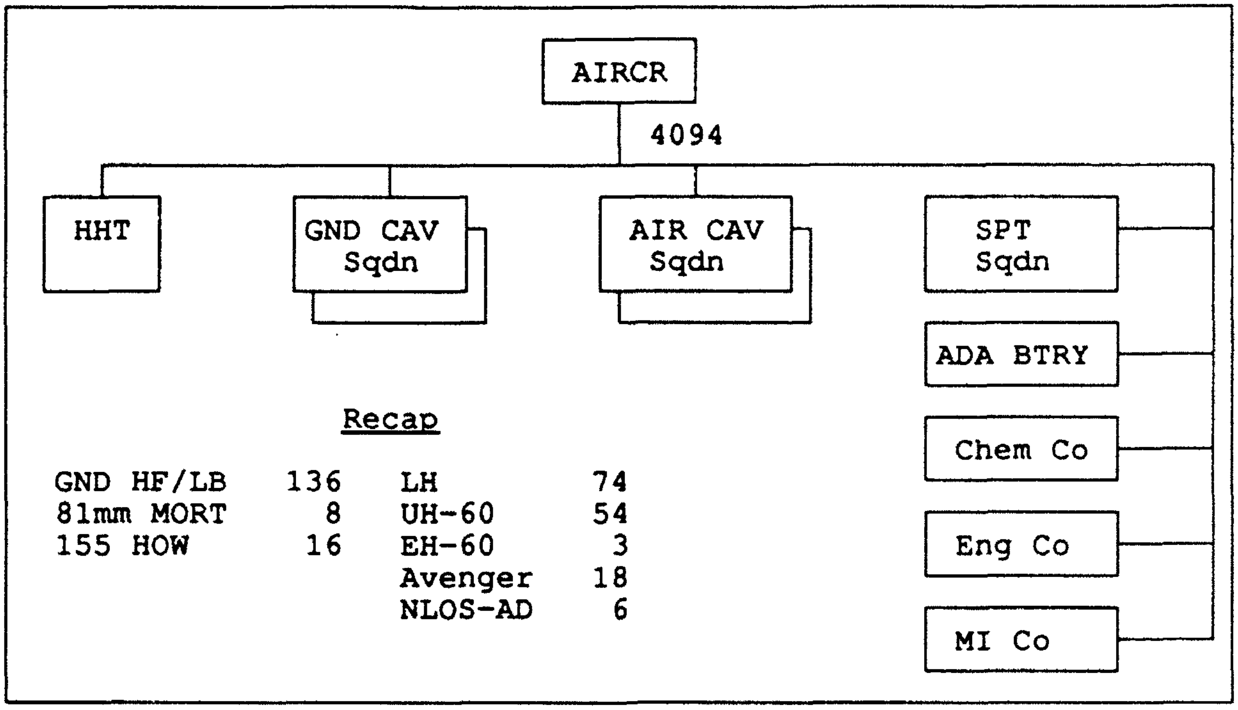

Figure 3. AIRCR (Aviation school design)

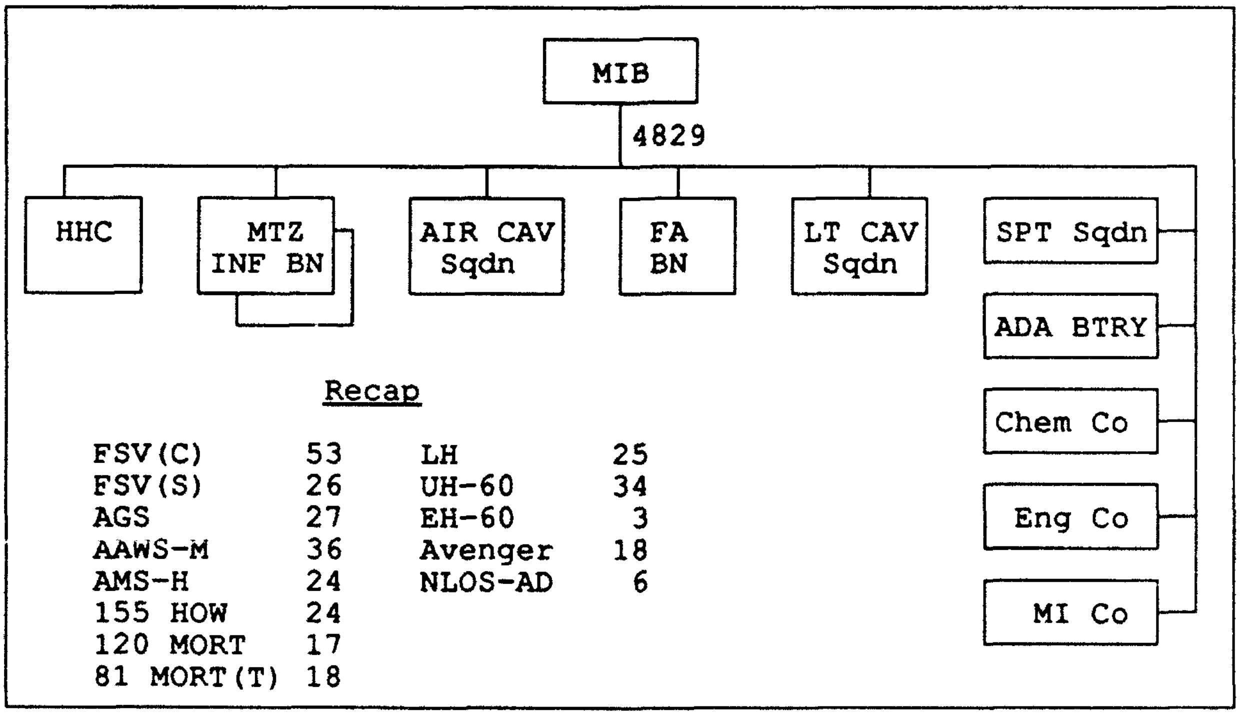

Figure 4. MIB (Infantry school design)

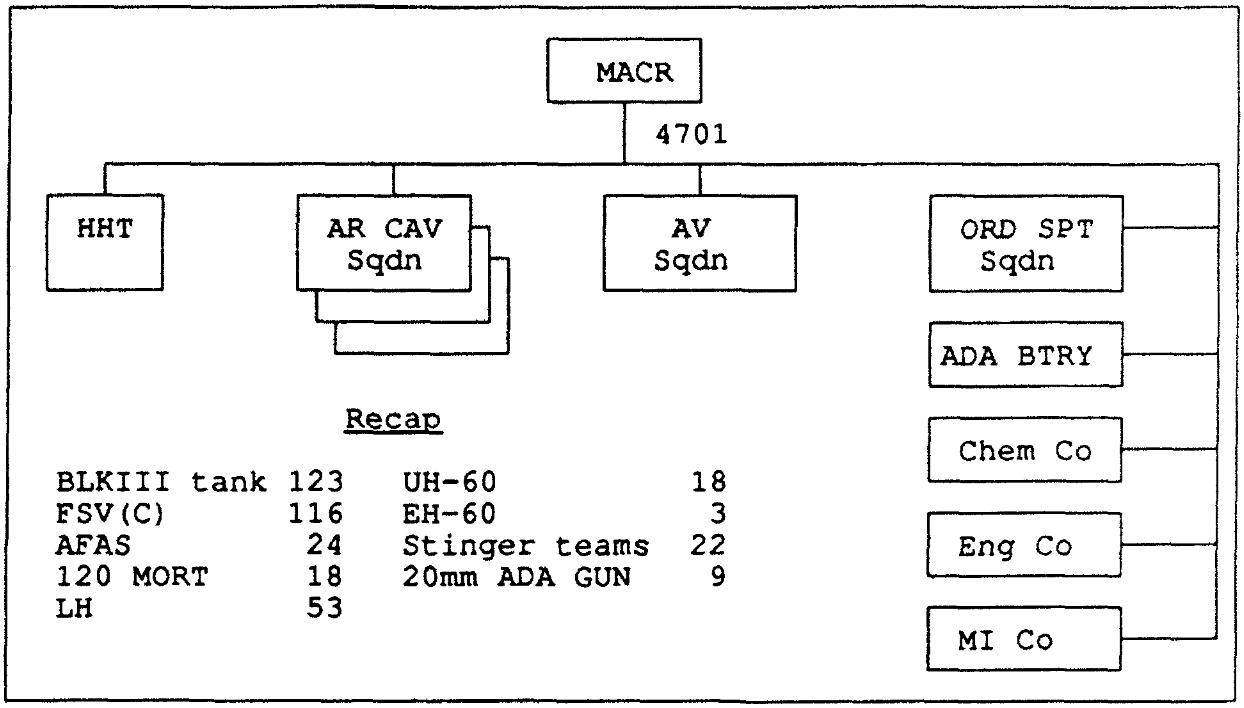

Figure 5. MACR (Modernized armored cavalry regiment)

(d) Each school had a representative at the Janus gaming facility when their respective force design was gamed. The representatives ensured the doctrinal correctness of the gaming of their respective force design.

(4) When the study was started, SWA and LATAM scenarios, which were conducive to evaluating cavalry missions, did not exist. Considering the time constraints for completing the study and the priority of the scenarios, CAC-CD concurred with TRAC's proposal to limit the analysis to only SWA scenarios. During an April 1991 IPR, the CAC Commander requested that additional analysis be conducted on close terrain and extended the time lines of the study. For this reason, the European scenario was added.

b. *Methodology.*

(1) Analytical support plan. Using the previously described list of requirements, the study methodology was determined and published in the Analytical Support Plan for the AGMC evaluation. The Analytical Support Plan included essential elements of analysis (EEA) which correlated to each of the quantifiable parameters. In addition, the measures of effectiveness (MOE) which correlated to the EEA are outlined. The EEA and MOE can be found in appendix B.

(2) Analytic tools. The major analytic tools used in this study were computer models. Mission analysis was conducted using both Janus and the Corps Battle Analyzer (CORBAN), high- and low-resolution computer simulations, respectively. Deployability was

accomplished with the aid of the Automated Air Load Planning Systems (AALPS), a logistical model for determination of sortie requirements. The costing portion relied on The Army Force Cost System (TAFCS), a cost model for development of future costs. Logistics implications were measured via Force Analysis Simulation of Theater Administration and Logistics Support (FASTALS), a theater-level model that determines support requirements. Mobility analysis consisted of spreadsheet calculations of volume and weight capability totals for the vehicles in each alternative and the comparison with requirements for volume and weight capacity based on personnel, equipment, common table allowances (CTA), and supplies.

(3) Mission analysis.

(a) The mission analysis was planned to focus on a SWA scenario. This scenario was developed from SWA 3.0 and was created specifically in support of this study. The low-resolution version encompassed a screen mission covering a 120km frontage with an on-order guard mission. The high-resolution view was split into two separate looks. One focused on a screen mission, and the other focused on a guard mission. Both high-resolution scenarios covered a 50km frontage. These scenarios were study certified by TRAC-Scenarios and Wargaming Center (TRAC-SWC).

(b) Additional mission analysis was added to the evaluation by LTG Wishart, Commander, CAC, during an April update briefing. The additional work included modernizing the ACR with 2004 equipment, gaming this design in SWA, and a close terrain analysis of all designs. The close terrain analysis consisted of a high-resolution European scenario. This scenario was based from EUR 9.0, depicted an ACR conducting a guard mission, and was study certified by TRAC-SWC. All high-resolution gaming was conducted by TRAC-White Sands Missile Range, New Mexico (TRAC-WSMR).

(4) Deployability. The AALPS model was used to determine aircraft sortie requirements for the deployment of each of the force designs and for resupply. The aircraft under consideration were C5A, C141, and C17. In addition to the proposed sortie calculations per alternative, a spreadsheet analysis for closure times was added. The closure times were computed from a parametric ranging (from 25 to 100 percent) of the aircraft available for force deployment.

(5) Costing. Costing for each of the designs focused on essential mission, mission support equipment, and personnel by category (officer, warrant officer, and enlisted). The cost categories which were identified were operations and maintenance (Army), military personnel (Army), and procurement. Nonrecurring and recurring costs over a 20-year period were rolled up as totals of the subordinate costs. Costs prior to fiscal year 1991 (FY91) were considered as sunk costs. All costs were presented in constant FY92 dollars. The sources for the cost analysis were both historical costing documents and TAFCS for development of future costs.

(6) Logistics impact analysis (LIA).

(a) The LIA was a comparative analysis performed to determine the logistic requirements for each of the force designs. Supply requirements were calculated for all classes with emphasis on classes III, V, VII, and IX. This analysis was conducted using a spreadsheet program that provided supply planning factors to be used along with FASTALS. This model calculates the average daily tonnage using a scenario to incorporate "combat intensity" into the requirements.

(b) Maintenance requirements were calculated using a spreadsheet program based on the annual maintenance manhour (AMMH) requirements by line item number (LIN) for the equipment in each alternative. Using production factors, these were then converted into mechanic manpower requirements.

(c) Combat service support (CSS) force structure implications were calculated for each design at echelons above division using the FASTALS model.

(7) Mobility. Each alternative was analyzed for sufficiency of vehicles and platforms to be 100 percent mobile. This included calculating the volume of space available on all vehicles and platforms and comparing this with the space required for the prescribed personnel, equipment, CTA, and supplies for each force design. In addition, these same calculations were done with respect to weight capacities and weight requirements.

c. *Mission findings.*

(1) Low resolution.

(a) For the low-resolution gaming, the CORBAN model was used. The base case ACR, the modernized ACR (MACR), and the alternative force designs were modeled. The corps perspective of this model allowed the entire regiment/brigade to be gamed along with corps assets which would be committed in support of this unit.

(b) For the SWA screen mission which was modeled, the corps assets available to the regiment consisted of one field artillery (FA) brigade (three battalions, multiple-launch rocket systems (MLRS), and 400 battlefield air interdiction (BAI) sorties. The MLRS battalions were linked to the regiment's forward targeting elements. The destruction capability of the MLRS, as keyed by the regimental assets, became a primary measure of effectiveness for these designs.

(c) The lethality and range of the corps MLRS assets, working with the intelligence provided by these units, brought destruction to the threat forces and eliminated the need for an on-order guard mission. Therefore, screening was the only mission actually evaluated.

(d) Key results from the CORBAN gaming are provided in table 1.

Table 1. CORBAN key results

	ACR	MACR	LCR	AIRCR	MIB
Blue regiment end strength (%)	84	98	90	90	78
Lead threat division recon strength (%) (regeneration)	82	48	30	0	55
Total Red maneuver battalions surviving (1st and 2d echelons)	27	23	14	11	16

(e) The ACR was outperformed by all alternative designs. The ACR depends on the AH-1F, AH-1S, and the OH58C for its helicopter assets. These systems were not as successful at stripping the threat recon as the light helicopter equipped with longbow (LH-LB) because of a lack of counterdetection capability and standoff. In addition, the small number of OH58C available for scouting limited the targeting information provided for corps assets. There is also no deep reconnaissance ground assets available to this design. This marks another void in this design's ability to go deep and kill deep. Without these assets, the ACR has to depend on the firepower and survivability of the bulk of its force--the M1 and M3. While these systems have adequate killing capability, they are forced into a closer fight and vulnerability becomes an issue.

(f) The MACR shows improvement over the ACR. The addition of the LH-LB gives the MACR the ability to go deep, call for fires, and to successfully attrite the threat recon. The replacement of the M3 by the future scout vehicle-cavalry (FSV(C)) gives this design the dimension of advanced technology which enhances survivability. The Block III tank also contributes to the increased survivability of this design. The MACR's main weakness is its lack of deep ground reconnaissance assets. Without the deep ground reconnaissance, this design must depend solely on the LH-LB for targeting information. This information stream is correlated to the flight assets which cannot be sustained over all frontages for the entire battle.

(g) The LCR used its deep reconnaissance capability of the future scout vehicle (scout) (FSV(S)) and the LH-LB to demonstrate the best control of threat tempo. The FSV(S) provided advanced technology which allowed it to go deep, remain unobserved, and provide sustained and effective detection of threat forces. The LH-LB added capability in the counterrecon role with its own firepower. The effectiveness of this design in providing targeting information and the corresponding destruction by the deep fires eliminated the need for a ground fight. Therefore, the corps look at this design does not provide any information on the other systems in this regiment. No weaknesses were identified for this design from the corps perspective.

(h) The AIRCR was also very successful from the corps perspective. The preponderance of LH-LB (74 systems) gave this design the ability to go deep, provide

targeting information, and success at attriting the threat recon. The LH-LB was capable of providing information on threat forces to the same depth as the FSV(S), but it was not capable of sustaining the detection stream to the same degree. The detection stream correlated and peaked with the flight patterns of the LH-LB. The strongest contribution of the AIRCR is in the ability of the LH-LB to perform counterrecon. The quantity of LH-LB allowed it to find the recon and, with its own firepower, destroy a large percentage. Again, the effectiveness of the deep fight eliminated the opportunity to evaluate other portions of the regiment.

(i) The MIB utilized the same systems as the LCR for the "go deep"/"kill deep" capability. These systems were the FSV(S) and the LH-LB. The distinguishing feature of this design is the quantities of these systems. While the LCR used 90 FSV(S), the MIB only contained 26. While the LCR used 53 LH-LB, the MIB only contained 25. So, while the tactics and systems were similar, the results were different because of the decreased ability to cover the same frontages.

(2) High resolution.

(a) The high-resolution analysis provides a different view of the combat potential of each design. While the CORBAN work considered the regiment/brigade as a whole and part of a corps perspective, the Janus work looks at a squadron (+) sized slice of the regiment. The high-resolution work will not address the deep reconnaissance assets. This work focuses on the ground cavalry squadron/MIB along with aviation assets covering only approximately a 50km by 50km terrain box. The small view required each of the proponents to choose a portion of their regiment that they feel would be used for this mission. The proponents were told to consider that the regiment must be capable of covering a 120km frontage, and they were required to apportion their forces appropriately. In addition to their own slice of the regiment, corps assets were given in support of the regiment. For the guard mission, a battalion of MLRS (27 tubes) and a battalion of 155 howitzers (24 tubes) were available. For the screen mission, a battery of MLRS (9 tubes) was available. Each proponent decided the exact number of tubes that were necessary for the mission corresponding to the desired tactics.

(b) The ACR was gamed to determine the current capabilities of an Army of Excellence (AOE) ACR versus the 2004 threat depicted in the AGMC evaluation. In the SWA screen mission, the ACR was capable of conducting the mission. This included stripping the entire threat recon. In the guard missions of SWA and of EUR, the ACR failed the mission and allowed the threat forces to reach their objective.

(c) Modernizing the ACR with 2004 equipment produced drastically different results. The futuristic equipment added both lethality and survivability. This MACR outperformed the base case in all scenarios and was successful at all missions. Since the organization and tactics remained consistent with those of the ACR, it becomes apparent that the added capability and success of this design is directly correlated to the equipment upgrade.

(d) In SWA, the tactics of the LCR and MIB were similar. They employed the ground systems forward and used them to make initial contact and strip thin-skinned recon vehicles. When the ground systems became vulnerable because of positioning, a battle handover was then conducted with the LH-LB. The LH-LB were used along with ground systems until mission success. The tactics of the AIRCR differed from the tactics of the other designs in SWA. The LH-LB were employed forward to make initial contact and strip the recon element. The ground systems were positioned behind the LH-LB to support them if the need developed. For both the screen and guard mission in SWA, the threat did not warrant the commitment of the ground systems and the LH-LB were capable of mission success.

(e) The European scenario presented a different threat and terrain. The close terrain in this scenario increased the incidence of shorter range, direct fire engagements and limited the use of the longer range systems because of line-of-sight restrictions. The terrain of this region drove the tactics of the three designs to a more similar nature. The ground systems became the major contributors across all three designs. Employed forward, the ground systems used a mixture of advanced technology and standoff according to inherent characteristics to make the ground fight a success. Only after initial contact and during the pull back of the ground systems did the LH-LB become significant contributors. The broken terrain proved vulnerable for the LH-LB.

(f) The strengths and weaknesses for the three proponent designs are summarized in tables 2 through 4. These tables highlight those features analyzed in Janus.

Table 2. LCR strengths and weaknesses

Strengths
- The FSV(C) provides survivability (advanced technology), target acquisition (battlefield positioning), and lethality (missile).
- The LH-LB provides great eyes and lethality.
- The AGS provides excellent long-range fires with Smart Target Activated Fire and Forget (STAFF) and good protection against dismounted infantry.
- Mix of weapons provides reasonable tactical flexibility.
Weaknesses
- FSV(C) lacks defense against dismounted infantry and are vulnerable to artillery.
- AGS must have STAFF to be effective in Europe.

Table 3. AIRCR strengths and weaknesses

Strengths
- The LH-LB provides great eyes and lethality.
- The HMMWV-LB provides excellent long-range antiarmor lethality and contributes to antihelicopter defense.
Weaknesses
- One technology dependent.
- Lack of close battle capability.

Table 4. MIB strengths and weaknesses

Strengths
- The FSV(C) provides survivability (advanced technology), target acquisition (battlefield positioning), and lethality (missile).
- The LH-LB provides great eyes and lethality.
- The AGS provides excellent long-range fires with STAFF and good protection against dismounted infantry.
- Dismount elements provide capability in close terrain.
Weaknesses
- FSV(C) lacks defense against dismounted infantry, is vulnerable to artillery, and cannot survive a close fight.
- AGS must have STAFF to be effective in Europe.
- Vulnerability of dismount.
- Limited contribution by AT-4.

(3) Deployability. Aircraft sorties were calculated for each of the designs using C-5, C-17, C-141/C-5, and C-141/C-17 combinations. The results produce an obvious distinction among the force designs. The base case and MACR required the greatest quantities for pure C-5 or C-17 deployments. For the same C-5 or C-17 deployments, the calculations show minimal differences among the alternatives. Using combinations of C-141 with C-5 and

C-17, the calculations still produce the greatest requirements for the ACR and the MACR. The alternatives are again closely matched with the LCR having a slightly larger requirement. Sorties for supplies were also calculated but had minimal effect on the total requirement for sorties. Total sorties for forces and supplies were presented in terms of closure time. This analysis was done parametrically assuming from 25 to 100 percent availability of aircraft. Again the ACR and the MACR were the most difficult to deploy with minimal differences among the alternatives.

(4) Costing. Each design was costed for nonrecurring and 20 years of recurring costs. Because this study is to support force design, costs were presented with and without personnel. The distribution, for both with and without personnel, shows three groups. The MACR is the most costly. The LCR and AIRCR designs are similar in costs, and the MIB is the least costly design. Except for the difference between the MACR and the MIB, the most expensive and the least expensive, these differences are not significant.

(5) LIA.

(a) For each of the alternatives, sustainment requirements were calculated for nine classes of supply and water. For those classes which correlate consumption to population, the ACR and the MACR had the largest requirements. Among the proponent alternatives, the MIB had the largest requirements for these classes based on a slightly larger population. These differences among the alternatives are not significant.

(b) For those classes which correlate requirements to the types and preponderance of equipment (classes III, V, VII, and IX), the ACR and the MACR have the largest requirement. Among the alternatives, the LCR has the greatest number of heavy equipment and correspondingly, the largest requirement. The MIB and AIRCR requirements are similar.

(c) Class V in this analysis was driven by the number of 155 tubes as the supply factors are implemented on a per tube basis. The ACR, MACR, and MIB have 24 tubes each which creates the largest class V requirement. The AIRCR and LCR are similar based on 16 tubes per design.

(d) Maintenance requirements per design demonstrate the largest requirement by the ACR followed closely by the aviation design. The older, heavy equipment of the ACR has large maintenance requirements. The AIRCR design has 131 aircraft with large numbers of flying hours which increase maintenance. The aircraft in the AIRCR design is almost double any other single design. The MACR is third in requirements based on improvements with 2004 upgrades in heavy equipment. The LCR and MIB show similarity in maintenance requirements.

(e) Overall, the logistics burden (maintenance and supply) is greatest for the heavy designs of the ACR and MACR. Overall, differences among the alternatives are minimal.

(6) Mobility. The mobility analysis was to ensure 100 percent mobility with organic assets. All designs were 100 percent mobile with organic resources. The ACR and the MACR are almost at cube-out stage. The alternative designs still afford room with consideration to both weight and volume.

4. Conclusions.

a. The comparison among the alternatives shows very little difference in the areas of deployability, mobility, costing, and logistics. There also exists similarities in the fact that all alternatives were successful in all missions evaluated. The true value of this comparison is not to determine which alternative is most successful but to outline those strengths and weaknesses identified. This information can be used to influence the final light cavalry design.

b. The corps analysis established the need for the light cavalry regiment to contain both a reconnaissance squadron and a regimental aviation squadron. The recon squadron must be equipped with systems of similar capability to that of the FSV(S). The ability of this organizational unit to go deep and provide sustained and effective detection streams was unmatched. The added capability of a regimental aviation squadron with the counterrecon capabilities of the LH-LB makes this regiment efficient and effective as it performs with corps assets.

c. The high-resolution analysis established the need for a light cavalry squadron which contains systems capable of scout functions and overwatch capability. The design most effective included the FSV(C) as the scout vehicle and the armored gun system (AGS) for overwatch. The FSV(C) used enhanced technology to remain unobserved and is equipped with a missile capability. The AGS offers a slightly more protected platform as it provides overwatch for withdrawal of the FSV(C). The teamwork of these systems was successful in both open and tight terrain.

d. The high-resolution work reconfirmed the conclusion of the corps effort which supports the necessity for a regimental aviation squadron. The size of the aviation assets was evaluated by a ranging which occurred naturally within the proponent designs. The MIB had 25 LH-LBs, the LCR had 53, and the AIRCR had 74. For the missions and terrains evaluated, the MIB had an insufficient number. The AIRCR had enough to enable them to complete the mission exclusively with LH-LB. The LCR used their LH-LB along with their ground systems and were successful. Based on the uncertainty of relying on only one system, the appropriate quantity is approximately 50 LH-LB.

e. The final conclusion from the Janus work is support of the requirement for dismounted infantry. The close terrain of Europe proved a valuable test for dismounts. In the tactics of the MIB in Europe, the dismounts were used forward on ambush routes. Equipped with antiarmor weapons system-medium (AAWS-M) they proved effective at destroying enemy lead vehicles. In even closer terrain which forbids vehicles, their value would be even more enhanced. It is an added flexibility for the regiment.

5. Recommendation. The recommendation of the study is that the strengths and weaknesses of the designs, previously stated in the conclusions, be considered into the design of the light cavalry. CAC-CD has the mission of incorporating both the analytic conclusions with their own assessment of unquantifiable parameters in the design process. The strengths determined by this analysis and the information provided in those areas where differences were not discerned, should provide the basis of this design.

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AIR GROUND MOTORIZED CAVALRY EVALUATION

CHAPTER 1

INTRODUCTION

1-1. Purpose. To evaluate the different force designs for strengths and weaknesses using the parameters and missions stated in the December 1990 CAC-CD memorandum.

1-2. Problem statement.

a. During a General Officer SWA MAPEX conducted at Fort Leavenworth on 2-3 July 1990, the TRADOC Commander tasked the Commandants of the Armor, Aviation, and Infantry schools to each develop, from their perspective, a corps level reconnaissance and security force for contingency operations. Specifically, the Armor school was to develop a LCR; the Aviation School an AIRCR; and the Infantry School a MIB modeled after the 9th Infantry Division. He also tasked the Combined Arms Command-Combat Developments (CAC-CD) Commander to evaluate the different force designs.

b. In a July 1990 message, CAC-CD provided design guidance to each of the proponent schools. It included the need to develop a brigade/regimental sized organization for the 2004 time frame to perform forward and flank reconnaissance, surveillance, security, and screening missions. The guidance also included the following design parameters for the organization:

(1) The organization must have global utility.

(2) The organization, to include sustainment, must be rapidly deployable (air).

(3) The organization must be self-contained, that is, capable of performing its own DS supply and maintenance.

(4) The organization must be packagable, that is, capable of being task organized into self-sustaining entities of less than brigade size.

(5) The corps will provide C2, as well as backup DS and GS support to the organization. The organization may expect to operate with and receive augmentation from corps or other theater forces.

(6) The organization will be 100 percent mobile with organic resources. It must have good off-road tactical mobility.

(7) The organization will be capable of 24-hour operations under all weather conditions.

(8) The organization will be capable of bringing long- range artillery and air fires to bear on known or suspected enemy locations.

(9) The organization will be capable of providing HUMINT verification of intelligence developed by technological means.

(10) The organization must be able to operate over extended ranges.

(11) The organization will be able to operate across the total spectrum of combat from low-to-high intensity.

c. In a December 1990 memorandum, CAC-CD requested analytical support from TRAC-OAC for selected missions and parameters which were readily quantifiable. CAC-CD planned to use TRAC-OAC's quantifiable results as part of their overall evaluation of the different force designs. The specific issues which were tasked and which provided the basis for the AGMC evaluation are listed below:

(1) Determine the number of sorties required to air deploy each of the force designs.

(2) Determine the required STONs/gallons of classes III and V for each of the force designs (daily rate and 30-day total). Additionally, determine the number of sorties required to resupply each of the force designs with classes III and V.

(3) Determine the force costs for each design. (Note: CAC-CD added this parameter after the July 1990 message was sent.)

(4) Determine if each of the force designs are 100 percent mobile with organic resources.

(5) Evaluate the ability of each of the force designs to accomplish the following missions:

(a) Surveillance.

(b) Screen.

(c) Guard.

(d) Covering force. (Note: CAC-CD deleted this mission from the evaluation during January 1991.)

(6) During the mission evaluations, determine the following:

(a) The ability of the force designs to bring long-range artillery and air fires to bear on known or suspected enemy locations.

(b) The ability of the force designs to provide HUMINT verification of intelligence developed by technological means.

(c) The ability of the force designs to operate at extended ranges.

d. CAC-CD's December 1990 memorandum also stated the following priorities for the scenarios to be used in the evaluation:

(1) SWA.

(2) LATAM.

(3) EUR.

1-3. Related efforts.

a. "Light Cavalry Regiment Analysis." October 1990. Fort Knox, KY.

(1) This study concentrated on Janus wargaming of various light cavalry designs. Fort Knox designed various combinations of light armor and aviation assets. In addition, the initial school designs from the Infantry and Aviation schools were analyzed by Fort Knox with assistance from Fort Rucker. These designs differed from those analyzed in AGMC.

(2) The scenarios of this effort were both open terrain of SWA and close terrain of EUR. Tactical deployment of the alternatives (air forward versus ground forward) was varied among runs. The missions and postures analyzed included reconnaissance, security, and economy of force.

(3) The results of the study state that a combined arms team is required to maximize the advantages of each system. The capabilities highlighted as important include: deep reconnaissance; a robust ground element for close reconnaissance, security, and economy of force; aviation for attack missions and rapid reaction requirements; engineers; artillery; Military Intelligence (MI); and CSS.

b. "Air/Ground Cavalry 1980-1985 Study." April 1979. TRAC, Fort Leavenworth.

(1) This study included objectives of determining missions appropriate for cavalry and determining an appropriate mix of systems for these types of missions. The first objective of determining appropriate missions was informative, but outside the scope of AGMC. The second objective was more appropriately aligned with AGMC.

(2) The effort to determine system mix included mission performance, as well as a risk assessment. While AGMC did use mission performance as a measurement, it did not include a risk assessment of the nature found in this study. Weather implications, availability of systems, and likelihood of a particular location for these missions was merged to determine

the "risk" inherent in each system mix. This information was valuable in a qualitative nature as AGMC considered future systems where some inherent risk has been eliminated and where perhaps other risks have surfaced.

1-4. Assumptions.

a. Threat doctrine and equipment projections through 2004 were accurate.

b. U.S. equipment projections through 2004 were accurate.

c. Future systems were defined in sufficient detail to allow for an accurate evaluation.

d. Approved surrogate data substituted for identified data deficiencies accurately represented the systems involved.

e. The warfight represented in the standard requirements code (SRC) 96 SWA scenario was appropriate for the purposes of the LIA.

f. The basic structure and support relationships for corps units would remain the same for all alternatives.

g. Classes of supply planning factor data from all sources adequately reflected supply requirements.

h. Maintenance requirements based on Army Regulation (AR) 570-2 (Army Manpower Authorization Requirements Criteria (MARC)) and the annual maintenance manhour data base (AMMDB) are representative of maintenance requirements.

i. The LIN surrogates used for maintenance and consumption calculation purposes for items of equipment without existing or adequate information were appropriate for this analysis.

j. The design of the alternative units was, or would be in the case of the MACR, adequate to meet internal support requirements for supply and maintenance support.

k. SRCs (AOE tables of organization and equipment (TOEs)) developed for AirLand Battle (ALB) can be used in an AirLand Battle-Future (ALB-F) study.

l. The leader military occupational specialty (MOS) used in FASTALS was representative of maintenance repairer types.

1-5. Scope.

a. *Limitations.*

(1) Initially, only three proposed alternatives were to be evaluated for a corps-level reconnaissance and security force. The three alternative force designs were:

(a) AIRCR. (Proposed by the Aviation school.)

(b) LCR. (Proposed by the Armor school.)

(c) MIB. (Proposed by the Infantry school.)

(2) Later, a MACR was added to the evaluation.

(3) The analysis was limited to those issues identified in the request for support (appendix A).

(4) Force costs for the base case and each of the alternative units was developed by costing at the same level of detail.

(a) Equipment lists included only essential and mission support equipment.

(b) Personnel costs were not included in the decision costs. However, since personnel (mostly military pay and allowances (MPA)) represents a large portion of the recurring costs, the number of categories of personnel, as well as the cost, was used in the sensitivity analysis for comparison purposes.

(5) The scenarios did not include nuclear, biological, or chemical warfare, or climatic variations.

b. *Constraints.*

(1) The request for support for this evaluation (appendix A) stated that the priorities for the scenarios were SWA, LATAM, and EUR. The lack of existing SWA and LATAM scenarios, which were conducive to evaluating cavalry operations, became a constraint of this evaluation because of the timelines of the evaluation. As a result of the low priority for using European scenarios, they were not initially used; however, in April 1991, the CAC Commander requested that the evaluation include a close terrain scenario (EUR) and he extended the timelines of the study to permit further evaluation.

(a) Low-resolution scenarios (LRS). No certified SWA or LATAM scenarios initially existed for evaluating cavalry missions in CORBAN model. A low-resolution scenario, LRS AGMC, was developed for the study using the SWA theatre context contained in the SWA 3.0 TRADOC standard scenario. It was used to evaluate a regimental-sized

cavalry unit performing a screen mission. Due to time constraints, a LATAM scenario could not be developed to support this study; thus, the only LRS used was LRS AGMC.

(b) High-resolution scenarios (HRS). No certified SWA or LATAM scenarios initially existed for evaluating cavalry missions; therefore, two SWA scenarios were developed: one for evaluating a guard mission (HRS AGMC 1.0), and one for evaluating a screen mission (HRS AGMC 2.0). Due to the time constraints of the study, the study team was not able to develop a LATAM scenario; the number of HRS was limited to the two SWA scenarios and one European scenario.

(2) This LIA was constrained in scope and depth by the specific study objectives and the timelines of the evaluation.

(3) Due to the low resolution of data defining the alternative units, maintenance manpower requirements are only expressed in terms of direct productive (enlisted) spaces. Any attempt to apply Standards of Grade Authorizations (SGA), (AR-611 series, Military Occupation Classification, Structure, and Implementation) and assign supervisory spaces to what would be marginal changes within a corps context, would have been purely conjectural.

AIR GROUND MOTORIZED CAVALRY EVALUATION

CHAPTER 2

METHODOLOGY

2-1. Study methodology.

a. *Analytical support plan.* The study methodology was published in the Analytical Support Plan for the AGMC evaluation. This document methodically establishes, for each quantifiable parameter, the appropriate EEA and the corresponding MOE. In addition, for mission analysis, success criteria were established to evaluate the mission "success or failure" for each alternative.

b. *Study team.* The study team charged with evaluating these parameters included TRAC elements from Fort Leavenworth, Fort Lee, VA, and WSMR, as well as representatives from each participating school. Each representative was responsible for reviewing and providing input to the development of success criteria and the study plan in general. They were required to develop the tactics, techniques, and procedures appropriate for their design and to ensure that the analysis accurately reflected their intent. They attended all IPRs and were part of the process for reviewing analytic results.

c. *Literature search.* Front end analytics were accomplished by reviewing previously published efforts in the cavalry arena. These documents were reviewed and are summarized in chapter 1.

d. *Analytic tools.* The major analytic tools used in this study were computer models. Mission analysis was conducted using both Janus and CORBAN, and high- and low-resolution computer simulations, respectively. Deployability was accomplished with the aid of AALPS, an aircraft load planning model for determination of sortie requirements. The costing portion relied on TAFCS, a cost model for development of future costs. Logistics implications were measured via FASTALS, a theater-level model that determines support requirements. Mobility analysis consisted of spreadsheet calculations of volume and weight capability totals for the vehicles in each alternative and the comparison with requirements for volume and weight capacity based on personnel, equipment, CTA, and supplies.

e. *Mission analysis.*

(1) The mission analysis was planned to focus on a SWA scenario. This scenario was developed from SWA 3.0 and was created specifically in support of this study. The low-resolution version encompassed a screen mission on a 120km frontage with an on-order guard mission. The high-resolution view was split into two separate looks. One focused on a screen mission, and the other focused on a guard mission. Both HRSs covered a 50km frontage. These scenarios were study certified by TRAC-SWC.

(2) Additional mission analysis was added to the evaluation by LTG Wishart (who was at that time the Commander of CAC) during an April update briefing. The additional work included "modernizing" the ACR with 2004 equipment, gaming this design in SWA, and a close terrain analysis of all designs. The close terrain analysis consisted of a high-resolution European scenario. This scenario was based on EUR 9.0, depicted an ACR conducting a guard mission, and was study certified by TRAC-SWC. All high-resolution gaming was conducted by TRAC-WSMR.

f. *Deployability*. The AALPS model was used to determine aircraft sortie requirements for the deployment of each of the force designs and for resupply. The aircraft under consideration were C5A, C141, and C17. In addition to the proposed sortie calculations per alternative, closure times were added to the analysis. The closure times were calculated parametrically based on availability of aircraft ranging from 25 to 100 percent available.

g. *Costing*. Costing for each of the designs focused on essential mission, mission support equipment, and personnel by category (officer, warrant officer, and enlisted). The cost categories, which were identified, were operations and maintenance (Army), military personnel (Army), and procurement. Nonrecurring and recurring costs over a 20-year period were rolled up as totals of the subordinate costs. Costs prior to FY91 were considered as sunk costs. All costs were presented in constant FY92 dollars. The sources for the cost analysis were both historical costing documents and TAFCS for development of future costs.

h. *LIA*.

(1) The LIA was a comparative analysis performed to determine the logistic requirements for each of the force designs. Supply requirements were calculated for all classes with emphasis on classes III, V, VII, and IX. This analysis was prepared using spreadsheet analysis that provided supply planning factors to be used with FASTALS. This model calculates the average daily tonnage using a scenario to incorporate "combat intensity" into the requirements.

(2) Maintenance requirements were calculated using a spreadsheet analysis based on the AMMH requirements by LIN for the equipment in each alternative. Using production factors these were then converted into mechanic manpower requirements.

(3) Transportation requirements based on classes III and V were calculated for each design.

(4) CSS force structure implications were calculated for each design at echelons above division based on the output from FASTALS.

i. *Mobility*. Each alternative was analyzed for sufficiency of vehicles and platforms to be 100 percent mobile. This included calculating the volume of space available on all vehicles and platforms and comparing this with the space required for the prescribed

personnel, equipment, CTA, and supplies for each force design. In addition, these same calculations were done with respect to weight capacities and weight requirements.

2-2. Alternatives. The following definitions provide a brief description of each of the alternatives considered in the AGMC study. Figures 2-1 through 2-5 portray each alternative.

a. *Base case.* This force is the Total Army Analysis (TAA96) programmed force design for a heavy division (see figure 2-1).

b. *LCR.* This design depends on two light cavalry squadrons, one regimental aviation squadron, a light armor battalion and a deep reconnaissance squadron. The key systems in this design are the FSV(S) for deep reconnaissance, the FSV(C) for close scout functions, the AGS for overwatch, and the LH-LB for air cavalry missions (see figure 2-2).

c. *AIRCR.* This design centers on a balance of two ground cavalry squadrons paired with two air cavalry squadrons. The key systems in this design are the LH-LB for air cavalry missions and the LB technology mounted on a high-mobility multipurpose wheeled vehicle (HMMWV) chassis (HV-LB) for ground cavalry missions (see figure 2-3).

d. *MIB.* This design emphasizes two motorized infantry battalions, one air cavalry squadron, a field artillery battalion, and a light cavalry squadron. The key systems in this design are the FSV(S), FSV(C), AGS, and LH-LB. The tactical employment of these systems is similar to that of the LCR. In addition, this design has dismount infantry for conditions, environments, and threats appropriate (see figure 2-4).

e. *MACR.* This design maintains the structure of the ACR but replaces the equipment with 2004 equipment (see figure 2-5).

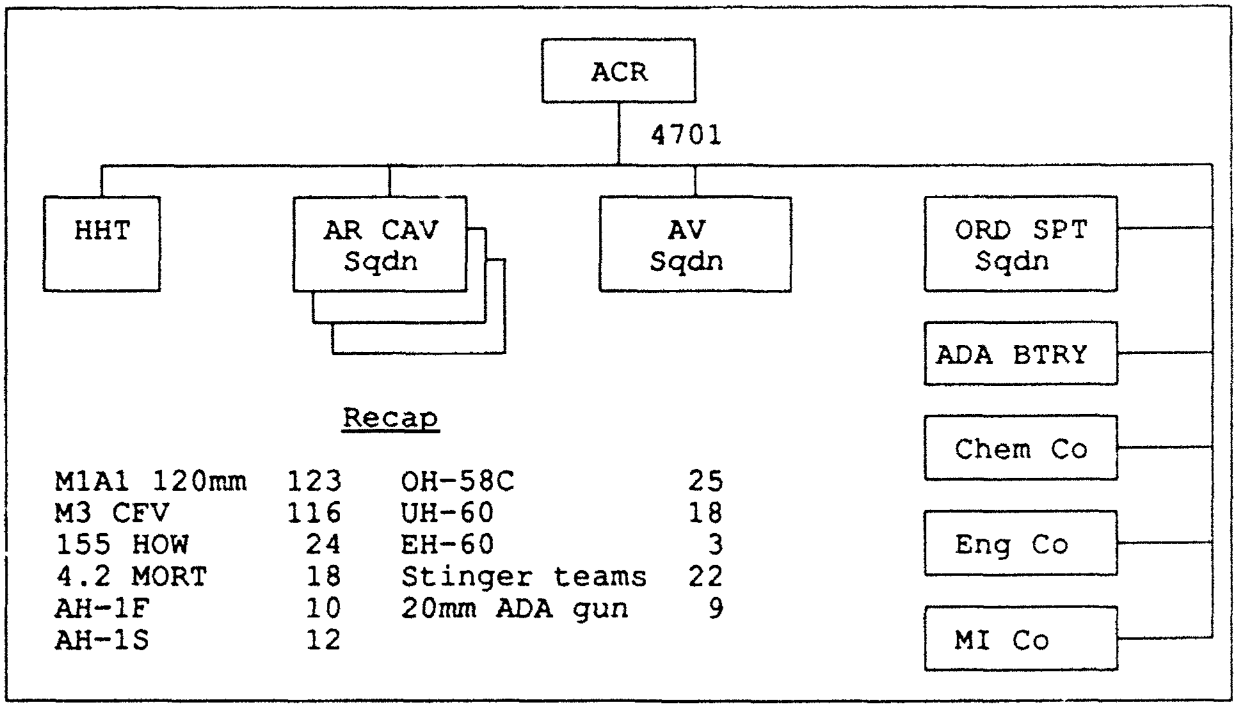

Figure 2-1. ACR base case objective AOE

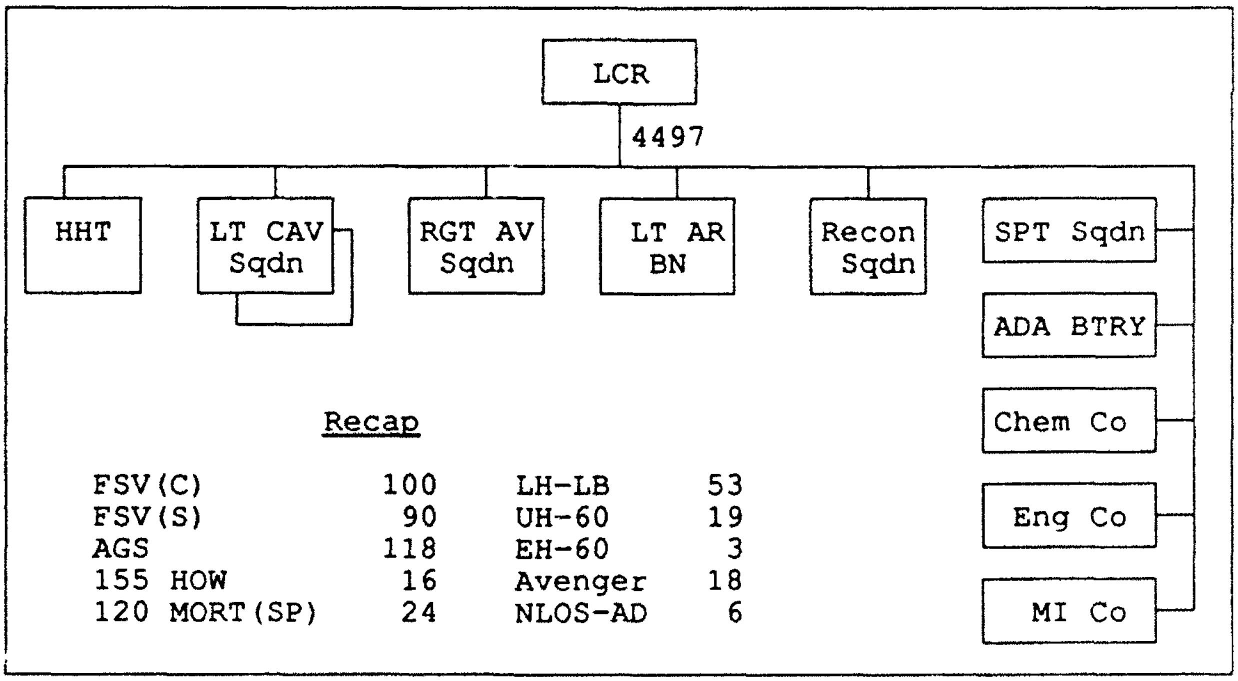

Figure 2-2. LCR (Armor school design)

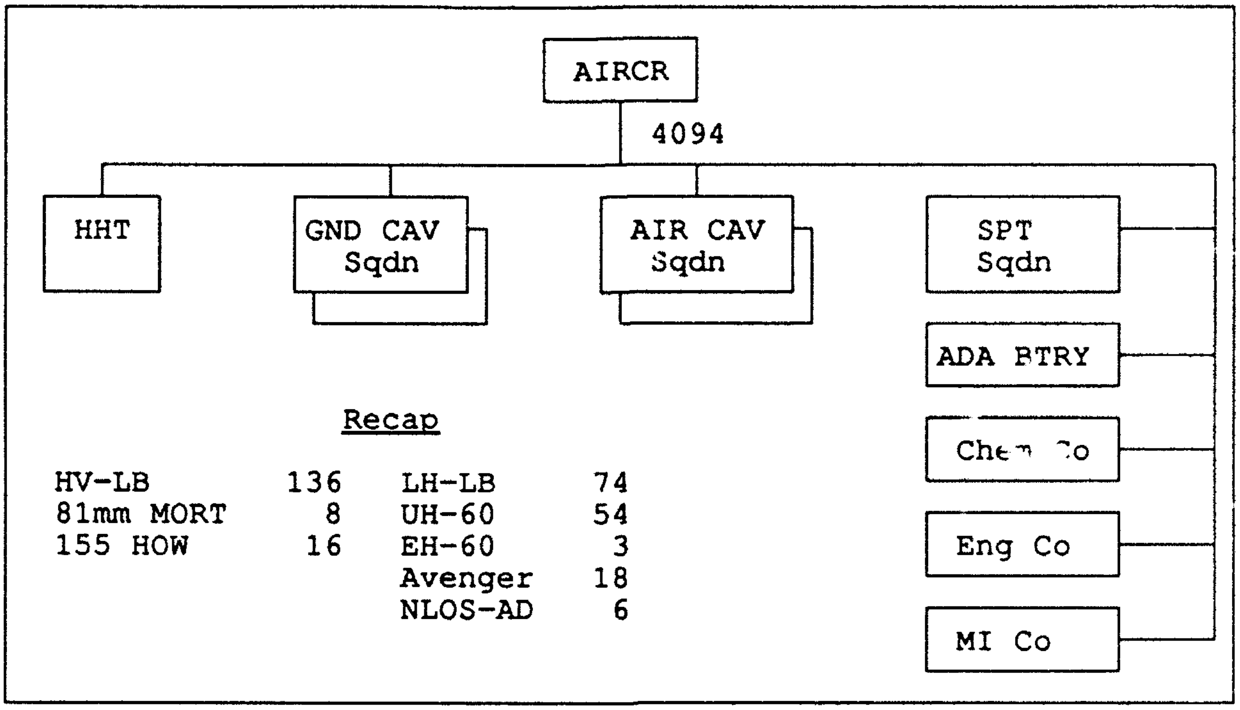

Figure 2-3. AIRCR (Aviation school design)

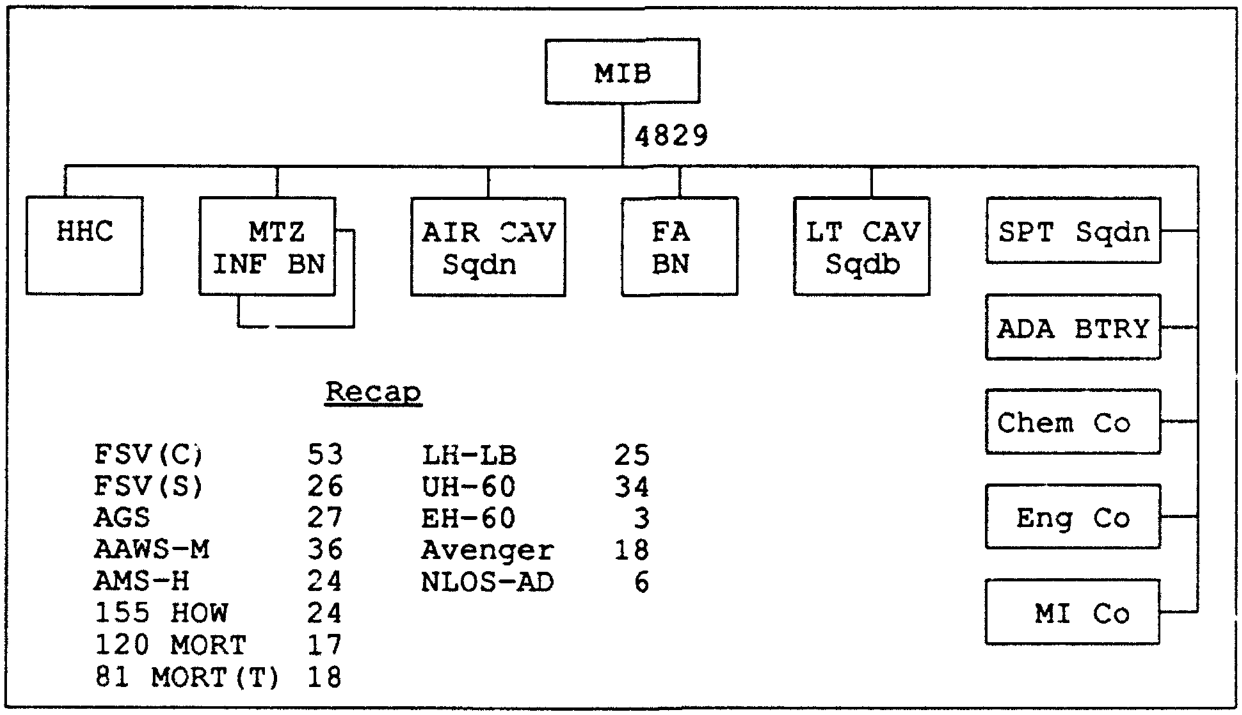

Figure 2-4. MIB (Infantry school design)

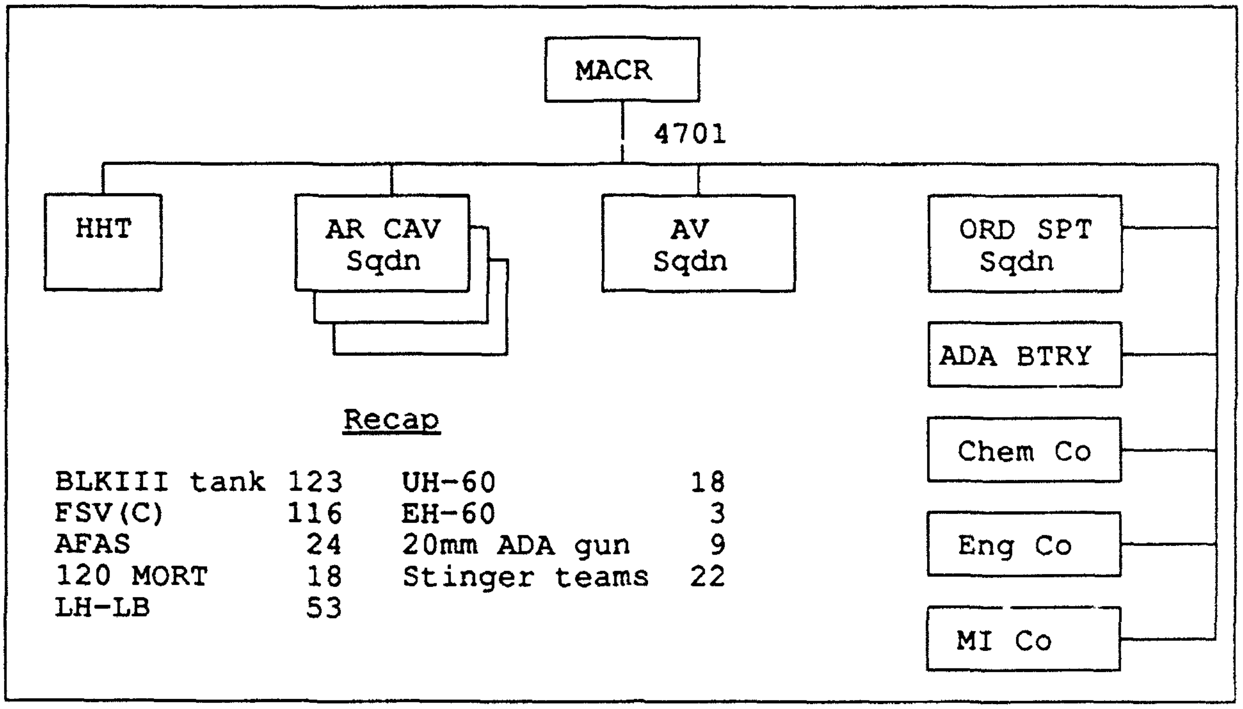

Figure 2-5. MACR

2-3. Success criteria.

a. General categories of the success criteria can be grouped into two areas.

(1) The first set of success criteria evaluate the mission success or failure of the alternatives at a high-resolution level (Janus).

(2) The second set of success criteria evaluate the mission success or failure of the alternatives at a low-resolution level (CORBAN).

b. The success criteria are listed and answered in appendix C.

2-4. EEA.

a. General categories of the EEA can be grouped into three areas.

(1) The first set of EEA evaluates the deployability and mobility requirements of each design. The corresponding EEAs are 1, 2, and 6.

(2) The second set of EEA evaluates the costing and logistics implications of each design. The corresponding EEAs are 3 through 5.5.

(3) The third set of EEA evaluates the mission performance of each design. The corresponding EEAs are 7 through 18.

b. The EEAs are listed and answered in appendix B.

2-5. Models. Candidate models and analytic tools include:

a. *Janus*. Janus is a high-resolution brigade/battalion-level, stochastic model. Two SWA and one EUR HRS reflecting a guard and screen mission were modeled to discern differences among the various force designs at the squadron level.

b. *CORBAN*. CORBAN is a low-resolution, corps-level, deterministic model. A low-resolution SWA screening mission was modeled to discern differences among the various force designs at the regimental level.

c. *AALPS*. AALPS is a logistical model which was used to determine aircraft sortie requirements for deployment and sustainment. This model will provide sortie requirements for C5A, C17, and C141 aircraft.

d. *TAFCS*. TAFCS is a cost model which was used by TRAC-WSMR in the development of future costs.

e. *FASTALS*. FASTALS is a theater-level force "roundout" model that computes the logistic workloads generated within a theater and determines the combat support (CS) and CSS units that are doctrinally required to support it.

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AIR GROUND MOTORIZED CAVALRY EVALUATION

CHAPTER 3

FINDINGS

3-1. Gaming. Gaming was conducted in two models; a low resolution corps-level deterministic model called CORBAN and a high-resolution brigade-level stochastic model called Janus. Both models gamed study scenarios based on the SWA 3.0 scenario with CORBAN concentrating on the overall corps fight, and Janus concentrating on specific screen and guard missions to discern differences among various force designs. Janus also gamed a portion of EUR 9.0 concentrating on the guard mission.

a. *CORBAN* (low-resolution mission analysis).

(1) Mission. The mission of the low-resolution production support team was to provide raw data and analysis for specific EEAs and other general areas specified by the study director. Specifically the team focused on the ability of the cavalry to target the enemy and bring deep fires, its HUMINT verification ability, countersurveillance capability, lethality, and survivability.

(2) Methodology.

(a) The low-resolution production team used the LRS AGMC scenario focusing on the screening mission of the 708th ACR in the east. The mission was to strip away the threat recon elements, shadow the movements of the main body, provide intel and deep fires data, and not become decisively engaged. The deep fires capability came from one FA brigade from corps in DS of the regiment.

(b) Each of the proponent schools worked hand in hand with the gamers to ensure that the proponent alternatives were gamed according to the school's plan, and that proper search patterns were designed for the forward scouts. In addition, the Armor school provided their expertise for the appropriate tactics of the ACR.

(3) Results.

(a) During the screen mission, all alternatives remained above 80 percent strength until 0600hrs D+5 (26 hours of gaming) when the guard mission could have been ordered. At the conclusion of the screen mission (40 hours of gaming), all alternatives had sufficient remaining strength (greater than 64 percent) to be able to conduct any follow-on mission. The unit strength for the base case and the alternatives gamed is provided in table 3-1.

Table 3-1. Key lethality/survivability results

	ACR	MACR	LCR	AIRCR	MIB
ACR % strength @ H+24 @ H+30 @ H+40(EOB)	88 88 84	98 98 98	91 91 90	90 90 90	89 89 78
Lead threat division recon BN strength @ H+30 @ EOB	 72 82*	 46 48	 24 30*	 19 0	 70 55
Number surviving MVR BNs in lead threat divisions/start @H+24 AVG BN % strength @ H+24	 16/42 55%	 18/42 50%	 6/42 40%	 9/42 62%	 9/42 60%
* (Regeneration)					

(b) Basic load data was input for all major weapon systems gamed in terms of ammunition and petroleum, oil, and lubricants (POL) for the CORBAN runs. This also included GS transport vehicles. All elements were started with maximum POL holdings and appropriate ammo constraints. Consumption rates for POL were provided from surrogate Vector-In-Commander (VIC) data.

1. Of the three alternatives gamed, the aviation alternative consumed the most POL. This was primarily due to the large number of LH-LB screen and deep missions. The MIB, with its extensive use of light vehicles and limited number of LH-LBs, proved to be the least resource intensive (see table 3-2).

2. Limited ground engagement, due to effective screening movements, provided little ammo consumption across the spectrum of alternatives. What was consumed was scenario driven. Organic artillery ammo consumption was higher in the ACR, MACR, and the MIB due to the higher number of artillery systems (24 vs 16). See consumption rates in tables 3-3.

Table 3-2. AGMC, low-resolution, fuel consumption (gallons)

	ACR	MACR	LCR	AIRCR	MIB
MVR	66,476	62,642	19,432	12,123	9,549
ARTY	5,617	8,428	4,050	4,401	7,831
HELO	51,108	82,849	85,103	127,313	49,689
Total	123,201	153,559	108,585	143,837	67,069

Table 3-3. Class V expenditures (rounds)

	ACR	MACR	LCR	AIRCR	MIB
Direct fire	68	112	222	559	59
Indirect artillery	4,622	6,128	1,614	2,075	3,025
Indirect mortar	0	86	52	27	639
HELO	2	211	280	387	106
Total	4,692	6,537	2,168	3,048	3,829

(c) The deep fire capability for the ACR and alternatives can be seen in table 3-4. The deep fire capability was provided by corps assets in the form of one FA brigade (3 BNs MLRS) directly linked to forward targeting elements of the regiment. The LCR and AIRCR provided the most effective use of deep fires to destroy the enemy. The deep scout elements of the LCR and MIB and the deep LH-LB missions of the AIRCR allowed for much greater C2 which resulted in more effective fires. The differences in the alternatives are equipment driven. Where the MIB alternative provided less forward FSVs, the results were a smaller search pattern and fewer fires. The BAI and other air fires were planned by corps and gamed without information from the alternatives; thus, no analysis was conducted.

Table 3-4. Deep fires targeting capability

BLOCK II	ACR	MACR	LCR	MIB	AIRCR
Number engagements	15	16	13	11	14
On number targets	15	14	13	10	11
1st time to engage (avg of 3 sectors)	5:40	4:00	2:25	4:10	2:35
Average range	62.8km	60km	80.9km	85.4km	77.7km
TGW					
Number engagements	24	20	29	21	35
On number targets	21 (12 Blk II repeats)	19 (9 Blk II repeats)	27	21 (1 Blk II repeat)	29
1st time to engage	5:40	4:00	4:30	6:10	4:30
Average range	32.7km	32km	27.8km	36.0km	30.1km
Total no. indiv. MVR BNs engaged	15+(21-12)=24 9	14+(19-9)=24	13+27=40	10+(21-1)=30 20	11+29=40
Number rendered ineffective	23	24	39	29	39
Number destroyed in engagement	22	22	39	29	39
2d ECH Eng/destroyed (by Blk II)	0/0	2/2	6/6	4/3	8/7

(d) A chart developed to present percentage of maneuver units detected by time is provided at figure 3-1. The percent detected is based on the number seen vs remaining committed units. The LCR alternative, with the largest forward deployed scouts, provides a larger detection area and better detection capabilities at earlier times and better sustainment. The AIRCR is not as sustained as the LCR because of the downtime required to rearm and refuel. This downtime causes surges in the AIRCR surveillance capabilities. These surge periods can be seen in the "dips" in the line graph in figure 3-1. The MIB provides for less forward deployed scouts which resulted in a smaller search pattern and a corresponding reduction in surveillance capabilities and fewer detections.

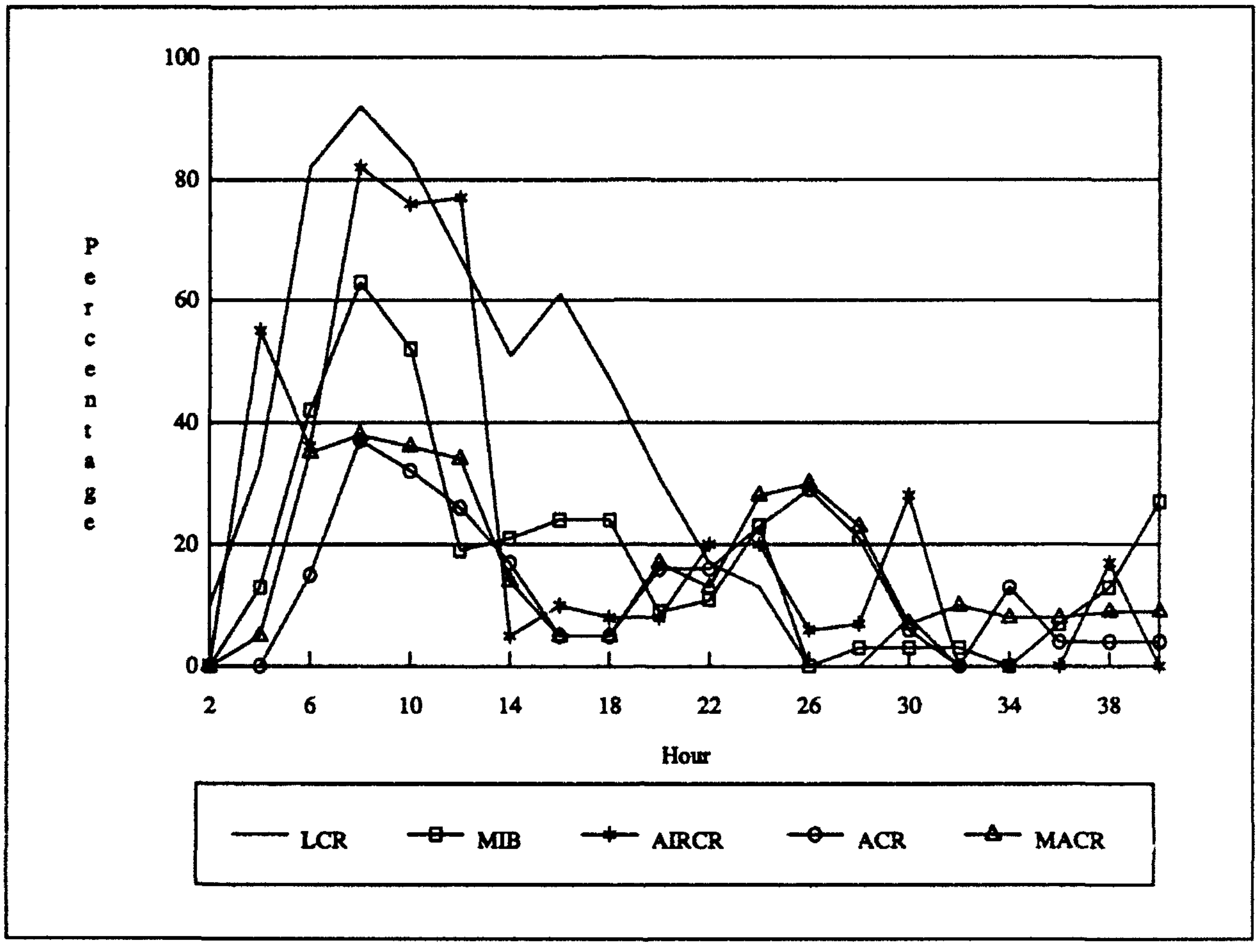


Figure 3-1. Percentage of maneuver units detected

(4) Conclusion.

(a) All three alternatives offer approximately the same results in terms of survivability; however, the LCR and AIRCR alternatives offer more in lethality. The trade-off for time and space, while not becoming decisively engaged, is accomplished with greater lethality in the LCR and AIRCR due to a better forward look capability. Counterrecon is markedly better in all three alternatives vs the base case with the AIRCR achieving results much sooner through the use of deep LH-LB attack missions. All three alternatives, with the use of corps assets, are able to defeat the lead divisions before it becomes necessary to perform a guard mission. However, the LCR alternative is able to destroy the entire lead divisions early on, which provides the corps commander with greater flexibility. The AIRCR does surpass the LCR alternative in overall lethality (using LH-LB attack runs), but does so much later in the battle (H+36).

(b) The combination of future/advanced weapon systems in all three alternative design proposals allow those proposals to outperform the base case. The combined effects of employing the FSVs to provide deep targeting data or using the LH-LB in the same capacity greatly improves the effectiveness of the smart artillery systems. Eyes on the ground can

can alleviate overtargeting. The HV-LB, while providing improved long-range lethality, lacks the survivability that may be required of the cavalry's main ground systems. The lethality of the smart artillery and the LH-LB, along with the effectiveness of organic fire support systems, limits the use of and resulting effects of the AGS, antiarmor missile system (heavy) (AMS-H), and the FSV(C).

(c) In summary, the LCR and AIRCR provide the best organization to execute the cavalry missions from a corps perspective in a SWA scenario. In particular, their timely detection and destruction of the enemy targets and counterrecon capabilities clearly stand above the ACR and the MIB alternative. The results are driven by the effectiveness and capabilities of future systems FSV(S) and FSV(C) and the LH-LB. The LCR provides for the most sustained and effective detection capabilities with a corresponding destruction capability. Any alternative decision should be based on the advantages demonstrated by the LCR.

b. *Janus* (high-resolution mission analysis).

(1) Mission. Three HRSs were modeled. Two of these scenarios were on SWA terrain and one was on European terrain. The SWA scenarios reflected a screen and guard mission, respectively. The European scenario was a guard mission. The terrain box was 50km by 50km for SWA and 45km by 45km for EUR.

(2) Methodology.

(a) The Janus terrain box was smaller than the required frontage of an entire regiment. Because of this, each of the proponent schools decided the quantity and mix of equipment that would be used for each mission. In addition to their own slice of the regiment, corps artillery assets were given in support of the regiment. For the guard mission, a battalion of MLRS (27 tubes) and a battalion of 155 howitzers (24 tubes) were available. For the screen mission, a battery of MLRS (9 tubes) was available. The proponents were not required to use all the artillery available. They decided on the number of tubes they would employ based on their tactics. The force structures actually modeled are provided in tables 3-5 and 3-6.

(b) The schools were required to position their forces on the terrain and provide the tactics that they felt were appropriate. All three schools were present for the production runs of their alternative. In addition, the Armor school provided their expertise for the appropriate tactics of the ACR.

Table 3-5. Force structure - base case

Blue (ACR)			MACR		Red (SWA)			Red (EUR)	
M1A1	41		M1A1 BLK III	41	T-72	106		FSTII	70
M3	38		FSV(C)	38	BMP	68		BMPFO	118
OH58C	12	(5)	LH-LB	26	HAVOC	4	(8)	HAVOC	12
AH-1F	14	(3)	MLRS	27	Hind	4	(8)	HOKUM	8
MLRS	27	(9)	MORT	6	Scorpion	27		SPAT	6
MORT	6		155 HOW	24	Ascavell	36		BRDM	12
155 HOW	24	(14)	PMS	4	ZSU	8	(12)	2S6	12
PMS	4				SA-13/8	8/0	(8/4)	SA-15	8
					122 MRL	36		122 MRL	18
					152 HOW	144		152 HOW	90
					210 HOW	36		203 HOW	18
					82 MORT	15		220 MRL	6
								300 MRL	6
								122 HOW	36
() Indicates changes for screen mission									

Table 3-6. Force structure - alternatives

System	LCR	AIRCR	MIB
AGS	44 (34)	--	9 (9)
FSV(C)	34 (34)	--	15 (15)
LH-LB	26 (6)	25 (18)	16 (4)
FSV(S)	10 (10)	--	8 (8)
MLRS	27 (9)	27 (9)	27 (9)
120 MORT	6 (6)	--	7 (7)
155 HOW	26 (14)	24 (8)	24 (6)
PMS	4 (4)	8 (12)	6 (6)
HV/AMS-H	--	--	8 (8)
HV/50 CAL	--	--	33 (33)
AAWS-M	--	4 (6)	12 (12)
HV-LB	--	37 (54)	--
() Indicates change for screen mission			

(3) Results. While the ACR was not to be used for comparisons with the alternatives, the results for the ACR are included in the following summary statistics.

(4) SWA guard mission.

(a) The guard mission required each alternative to guard the Blue forces that were using the pipeline road. Their mission was to prevent the Red forces from reaching the pipeline road. The desire was to remain combat effective (greater than 65 percent strength) in order to conduct follow-on missions.

(b) In addition to the differences in force structure, the tactics employed varied among alternatives. The tactics employed by the AIRCR called for putting the LH-LBs forward, ground systems slightly to the rear of the LH-LBs, and a plan which called for a battle turnover from air to ground if it became necessary. At no point in time did the threat present more than the capacity of LH-LBs. Artillery played a minor role.

(c) The tactics of the MIB and LCR were very similar to the ACR. The ground systems began forward. They were used effectively against the thin-skinned recon vehicles. When the longer range BMPs and T-72s came within range, the battle was turned over to the air assets. The long-range LH-LB missile was able to provide protection for the ground systems to move rearward to a stronghold position. Scouts were used in both of these alternatives to provide information on advancing Red units.

(d) The differences in tactics provide much of the basis for variances in results among the alternatives, but the major success criteria are exceeded by all alternatives. For this threat environment and conditions, it appears that various tactics are equally successful.

(5) SWA guard results.

(a) The force exchange ratios for the base case and all alternatives are provided in figure 3-2. Red losses are consistent across the alternatives based on end game criteria. End game criteria was attrition of 75 percent of the Red force or allowing the Red force to reach the pipeline road. The alternative designs each attrited the Red force to 25 percent, but the base case was unsuccessful in guarding the forces on the pipeline road, and the Red force broke through.

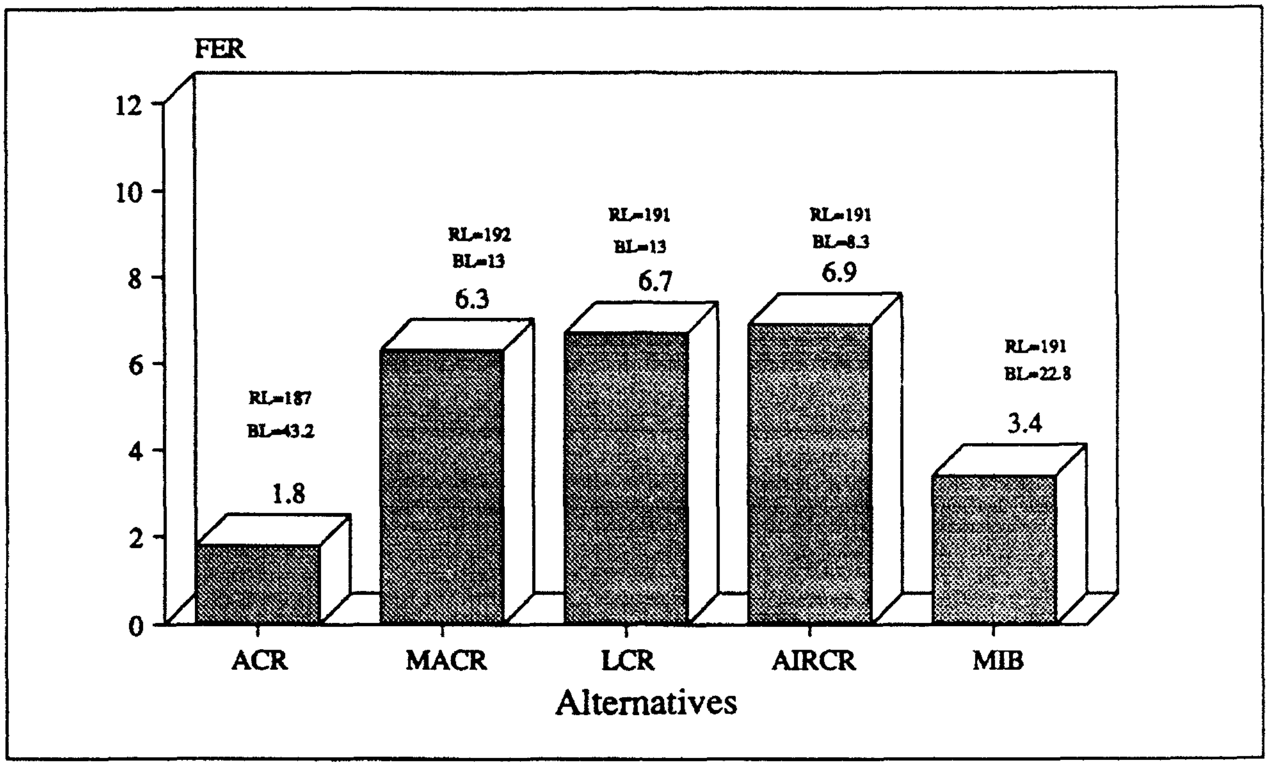


Figure 3-2. SWA force exchange ratio (guard)

(b) The majority of Blue losses across the alternatives was a result of Red artillery prepping the towns in the south. The large number of losses associated with the MIB is a result of the number of vulnerable short-range HMMWV troop carriers which were located in the towns for protection. The majority of Blue losses was not based on intelligence gained on the Blue force but by preparatory fires. Some losses from artillery were obtained when Red forces detected displacing Blue ground systems.

(c) The percent contribution by system type is provided in figure 3-3. The tactics previously explained closely correlate with the results in this table. In the AIRCR, the LH-LB was used exclusively and accounted for 99.6 percent of all Red killed. The MIB and LCR alternatives show a more combined arms fight with contributions from the ground systems. Regardless of the tactics, it becomes obvious that the range and lethality of the LH-LB missile dominates the fight in this scenario. The lack of participation by the M1A1 or AGS was not a function of the lethality of these systems but of the tactics used by the force commander. The tanks were positioned so as to protect the withdrawal of the cavalry elements and to counterattack if necessary. They accomplished their mission without becoming decisively engaged with minimum losses. They minimized their lethality by design and maneuver.

(d) The system exchange ratios (SER) are provided in figure 3-4. The SER is a ratio which reflects the number of Red systems killed by a certain Blue system divided by the number of that Blue system killed. In simple terms it signifies a return per system lost.

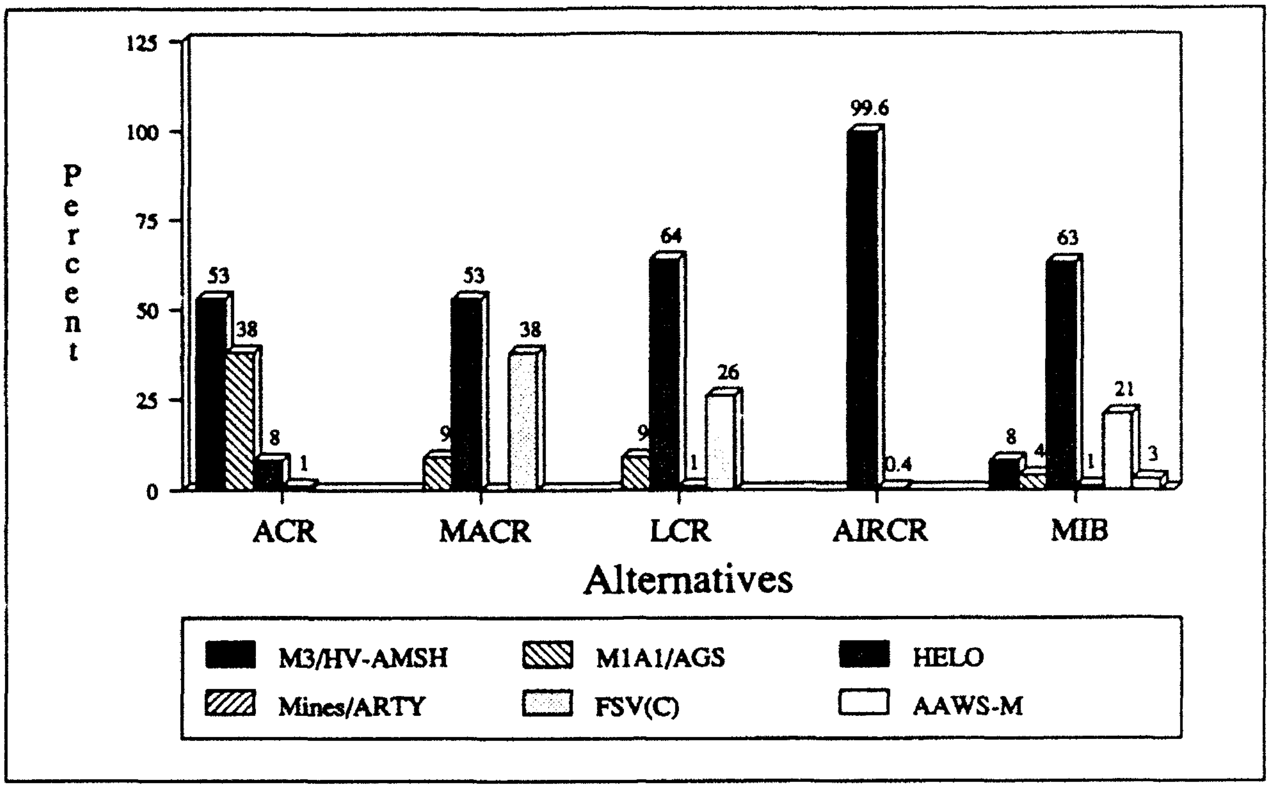


Figure 3-3. SWA percent contribution (guard)

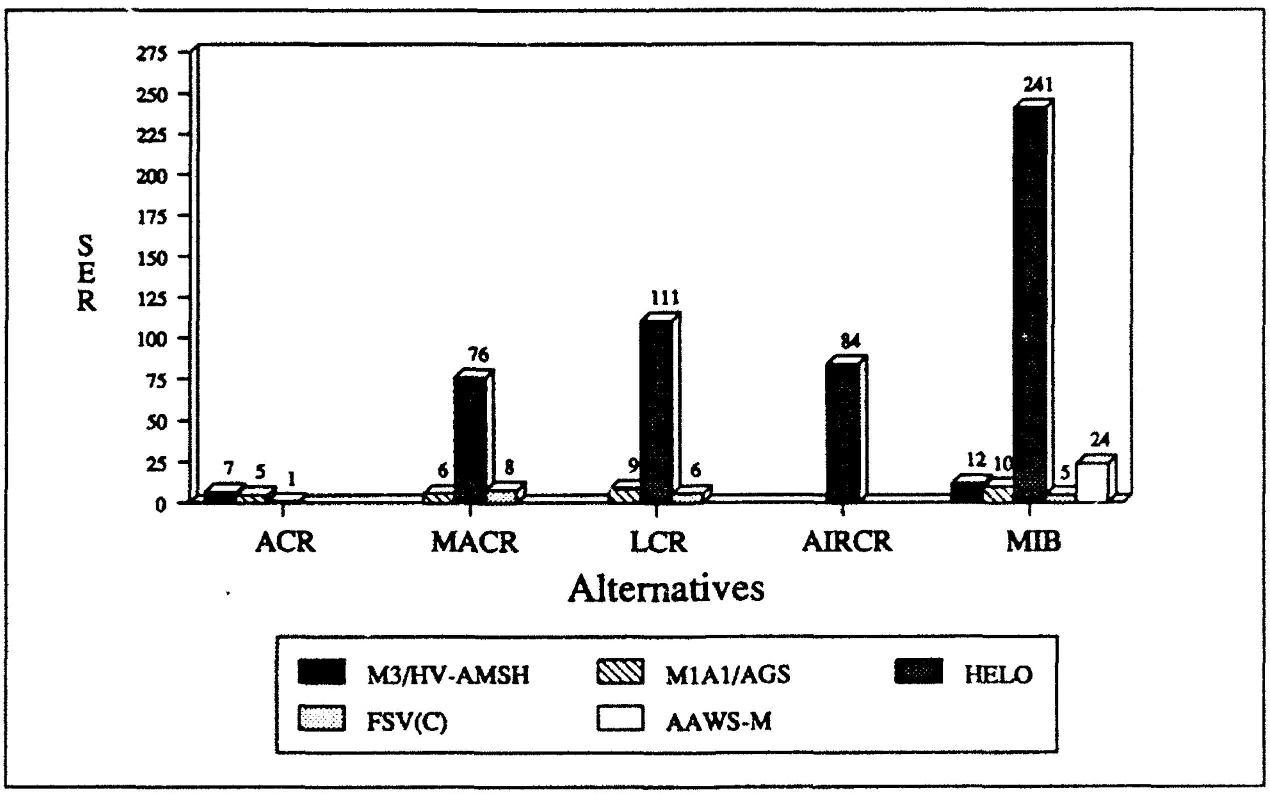


Figure 3-4. SWA SER (guard)

(e) Initial quantities of systems play a large role in the determination of these ratios. For example, the SER for the LH-LB in the MIB is the largest of the three alternatives. This does not reflect more kills for all the LH-LB in the MIB, but instead, depicts more Red kills per LH-LB kill. In the MIB the LH-LB was responsible for approximately 120 Red kills with 16 LH-LB employed and .5 LH-LB killed. In the AIRCR, the LH-LB was responsible for approximately 189 Red kills with 25 LH-LB employed and 2.25 LH-LB killed. The increase in Red kills in relation to the number of LH-LB seems to be proportional, but the LH-LB losses are disproportionate. The increase in LH-LB does provide more Red kills, but also increases the LH-LB vulnerability as a result. Therefore, the SER must be viewed with initial numbers in context.

(f) The kills per system employed are provided in figure 3-5. This MOE shows a measure of the efficiency of a system. It indicates to the tactical commander what he can expect a particular system to kill per system employed. It provides insight into both killing potential and needed system density. As can be seen in the figure, the LH-LB is the most efficient. In comparing the MIB and LCR, we see that with 10 less helicopters and generally the same tactical plan, the lesser number is more efficient. This efficiency is regained in the AIRCR when the aircraft are employed radically different. Essentially, the ground forces are removed and the aircraft do all the fighting. The commander can change efficiency of a particular system by changing tactics, but the risk of a one-system battle is considerable. The FSV(C) is the next best performer and would do much better if not for its vulnerability to artillery. The AGS and AAWS-M were poor performers. The AGS, as pointed out previously, because of its tactical role in the scheme of maneuver, and the AAWS-M, because of its limited range within the context of the terrain and mission.

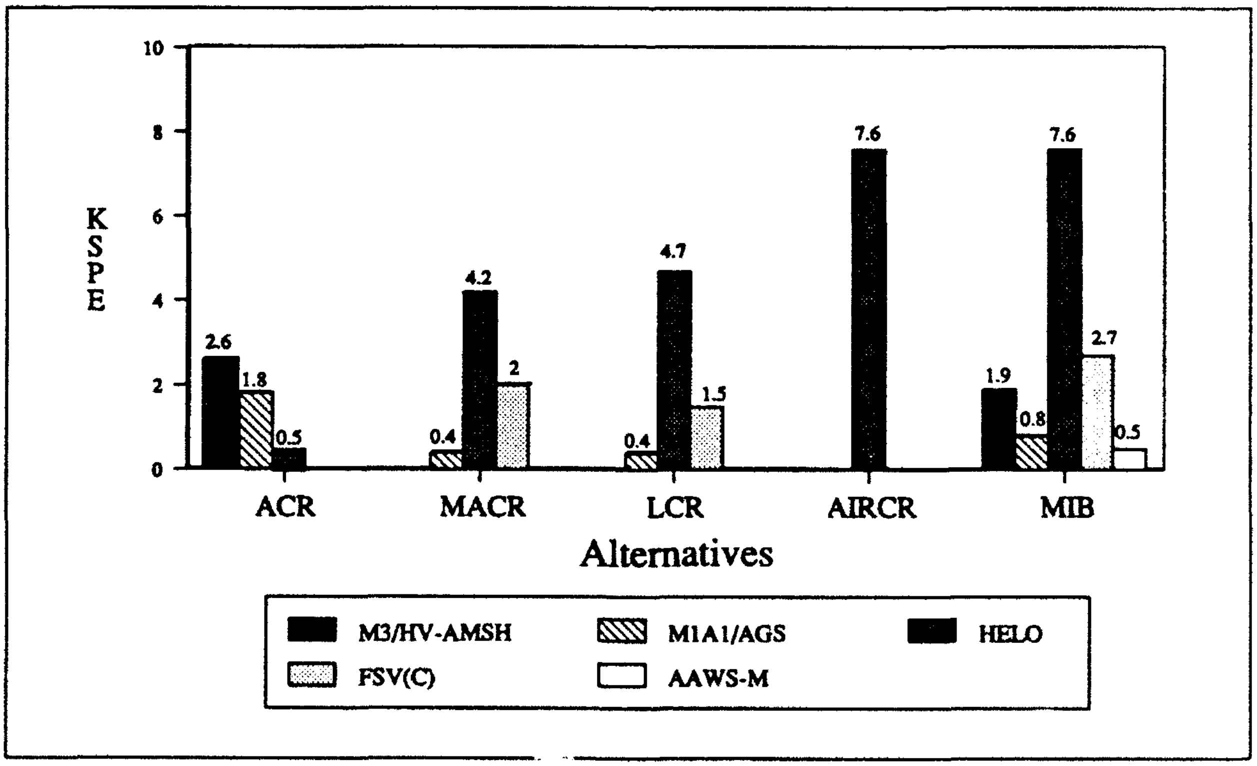


Figure 3-5. SWA kills per system employed (guard)

(6) SWA screen mission.

(a) The screen mission required each alternative to strip the threat recon elements, shadow the movement of the main body, provide information for targeting and intelligence purposes and targeting information, while not becoming decisively engaged. In addition, end game criteria required all preplanned Blue ground maneuver to be complete.

(b) Again, the tactics varied among the various alternatives. AIRCR used the LH-LB exclusively while MIB and LCR used a more combined arms approach.

(c) The MACR is not presented for the SWA screen mission.

(7) SWA screen mission results.

(a) The force exchange ratios for the ACR and all proponent alternatives are provided in figure 3-6. The dual end game criteria of stripping the recon and completion of preplanned ground maneuver caused the Red losses to vary. Again, correlated directly to tactics, the Red losses in the AIRCR are much larger than the MIB and LCR. The AIRCR so successfully screened with the LH-LBs that the Red forces did not present a threat to the Blue ground systems as early as it did in the other alternatives. This "lack" of threat allowed the Blue ground systems in the AIRCR to remain forward longer and therefore, the AIRCR was presented with more targets prior to end game criteria.

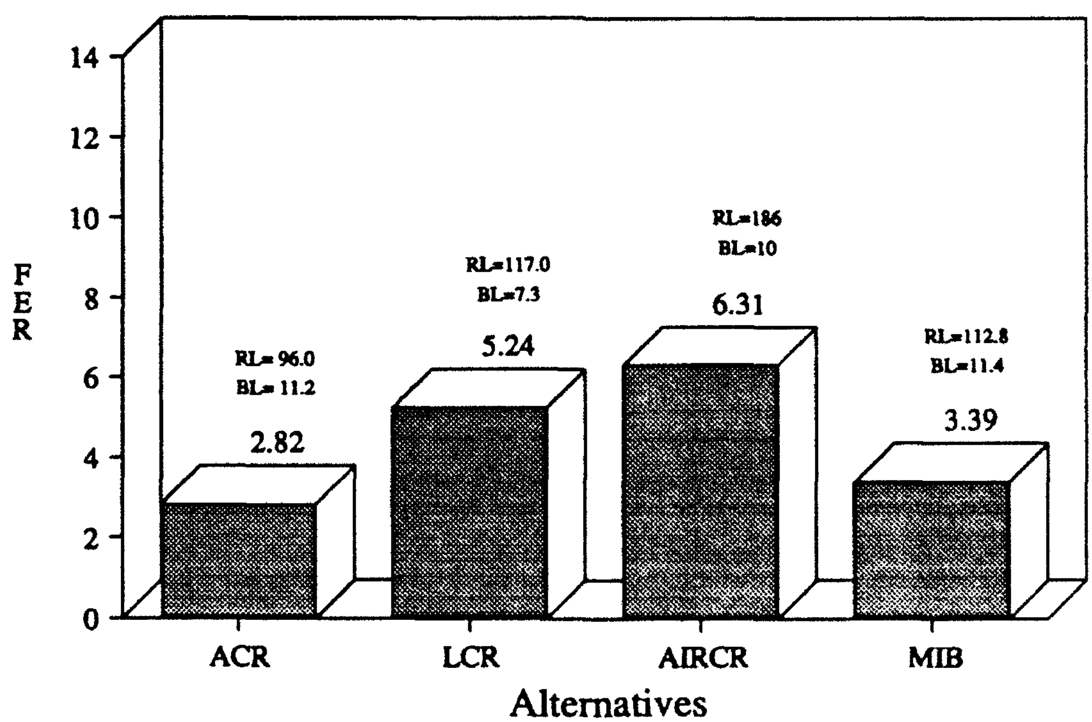


Figure 3-6. SWA force exchange ratios (screen)

(b) The variance in the number of Blue losses is attributed to both the vulnerability of the HMMWV/50CAL systems in the MIB and the extended amount of time that the LH-LBs remained forward in the AIRCR.

(c) The percent contribution by system type is provided in figure 3-7. Again, these numbers reflect the tactics of the organization. The AIRCR dominates with the LH-LB while MIB and LCR split the contribution between ground and air for a more combined arms approach. Again, the M1A1 or AGS positioning and mission precluded extended engagements.

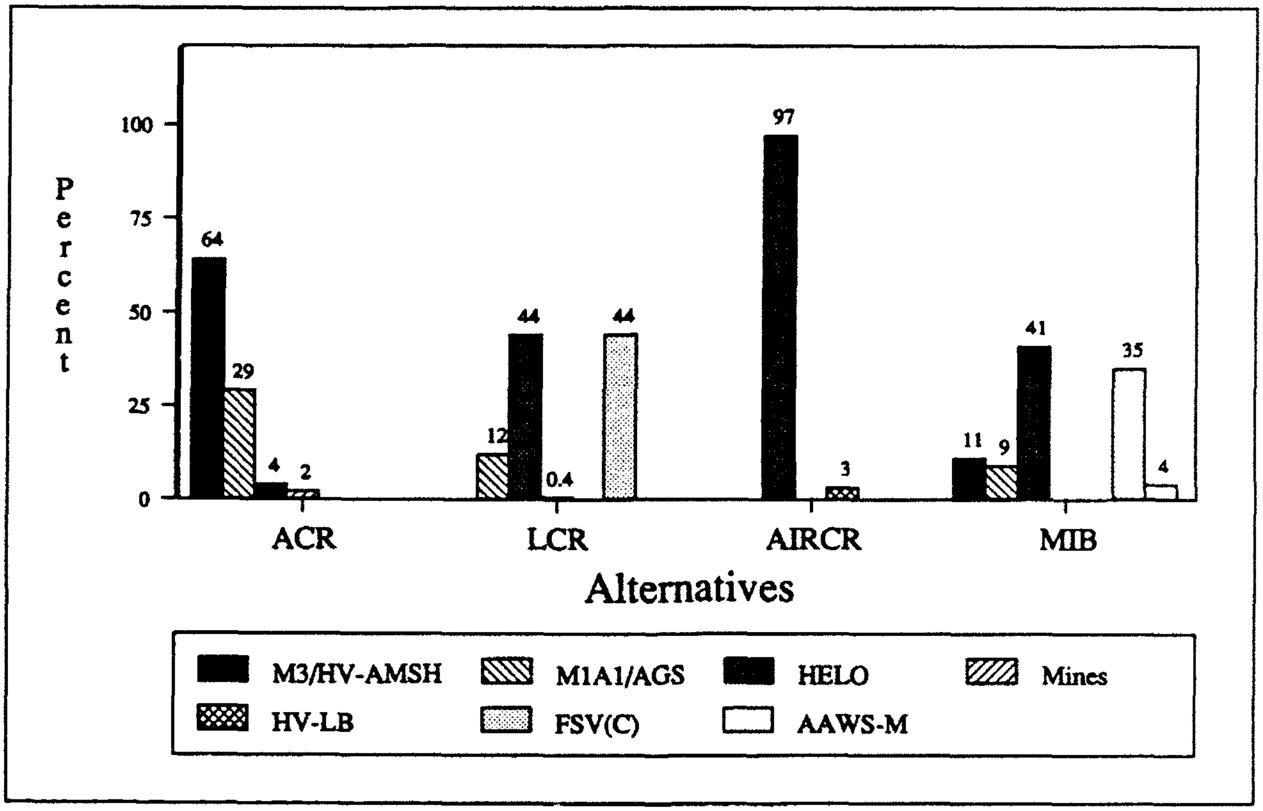


Figure 3-7. SWA percent contribution (screen)

(d) The SERs are provided in figure 3-8. The large contribution of the LH-LB as a killer and the relatively low vulnerability based on standoff provide significant large SERs for the LH-LB across alternatives. The AGS used in the MIB and LCR also provided a significant return per loss.

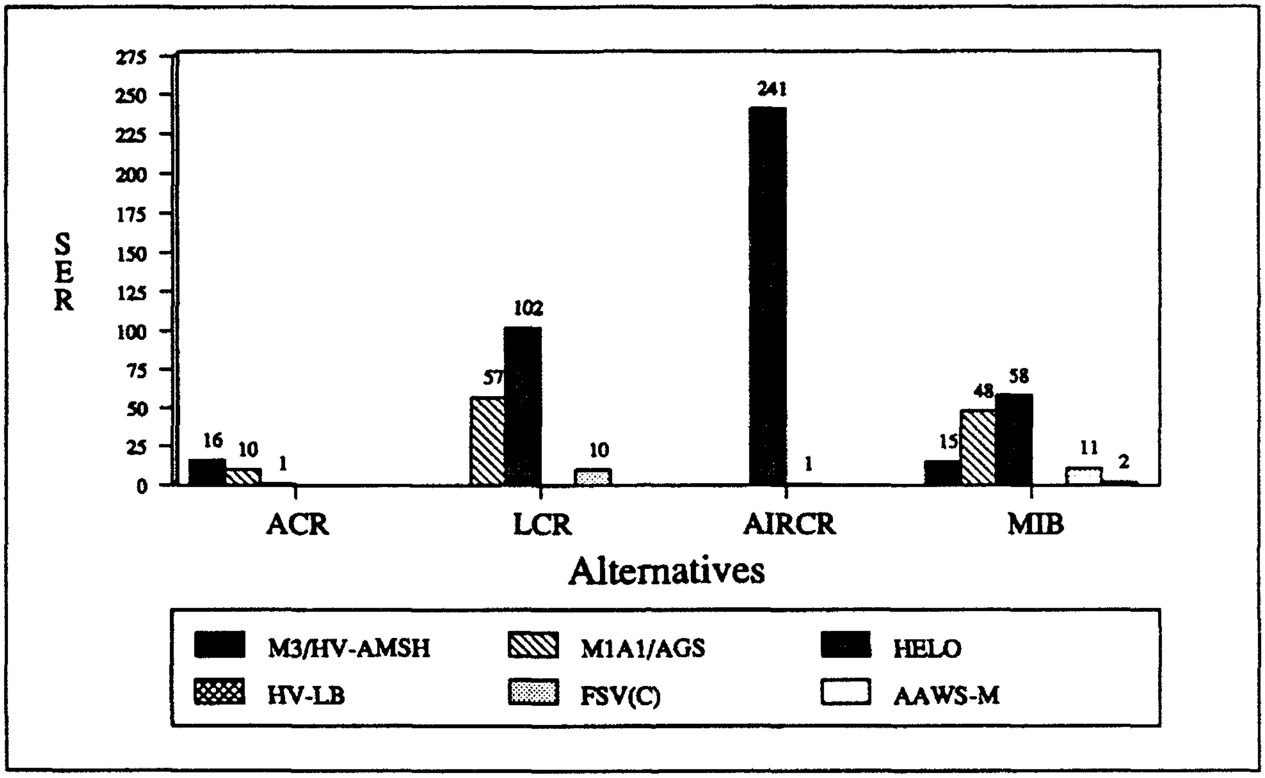


Figure 3-8. SWA SER (screen)

(e) The kills per system employed are provided in figure 3-9. For the ground systems, the results were almost precisely the same as for the guard. There were no significant differences. This provides strong evidence that the ground elements, at least for the MIB and LCR, engaged primarily the same type and amount of Red forces. Even though tactics changed between missions, the ground elements always engaged the Red recon forces and continued against the main body only when absolutely necessary. In the guard mission there were sufficient helicopters to do the job. In the screen mission, it was not required. The LH-LB were the only systems that improved their efficiency. The reasons were related to the tactics employed and the mission essentials. The aircraft were required to kill only the reconnaissance elements remaining after the ground engaged. Aircraft could maximize standoff ranges and not worry about assisting ground system withdrawal. The withdrawal occurred early and there was no contact with the Red main body.

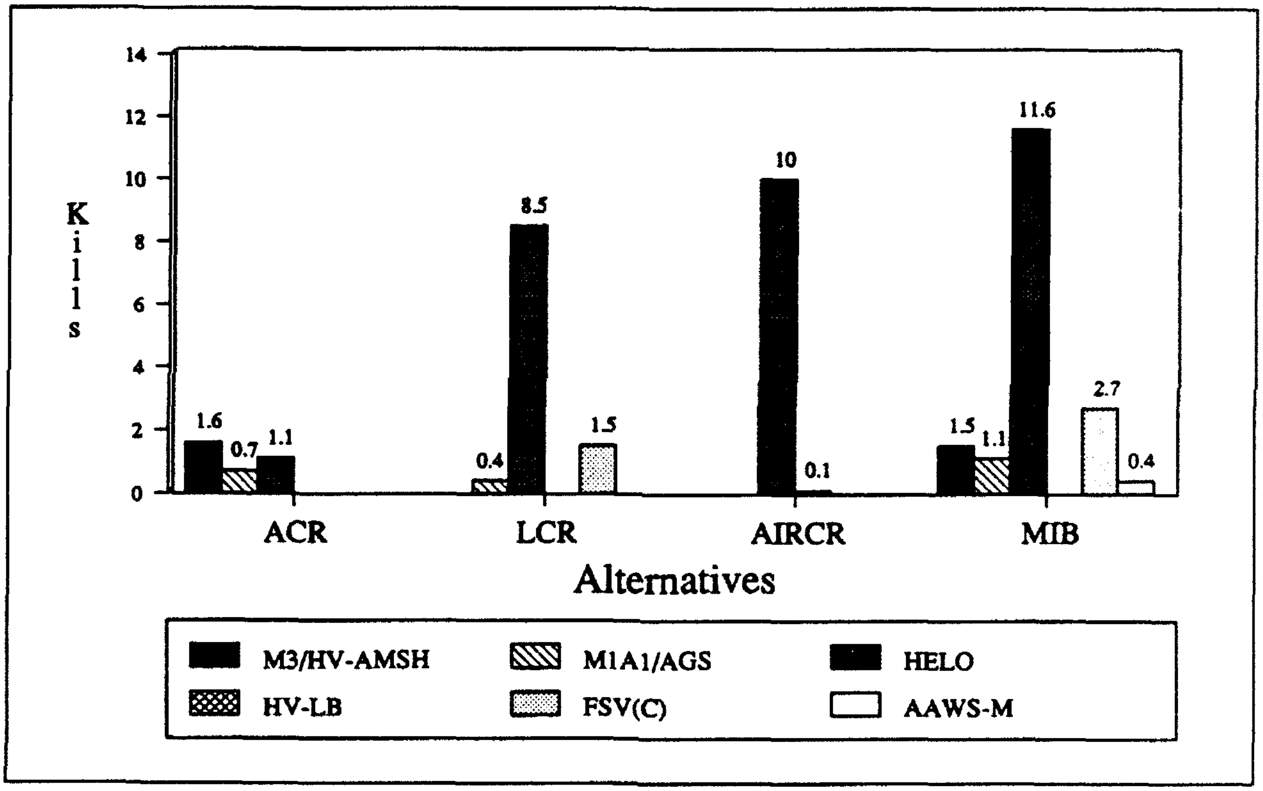


Figure 3-9. SWA kills per system employed (screen)

(8) EUR guard mission.

(a) The guard mission required each alternative to guard the Blue forces in the west. Their mission was to prevent the Red forces from reaching 35km west of their initial positions. The desire was to remain combat effective (greater than or equal to 65 percent strength) in order to conduct follow-on missions.

(b) In addition to the differences in force structures, the tactics employed varied among alternatives. The LCR and MIB placed their FSV(C) forward with AGS positioned 5km behind

the FSV(C). The advanced technology used by the FSV(C) allowed them to remain forward and strip much of the Red recon. When it became necessary to pull back the FSV(C), the AGS provided overwatch and offered increased survivability. LH-LBs were then used to conduct a battle handover from the AGS. This was truly a combined arms approach.

(c) The AIRCR also used a combined arms approach with ground systems and air assets. The ground system of the AIRCR is the HV-LB. This system accounted for 75 percent of the systems contribution in this scenario. The major advantages of the AIRCR are commonality of ammunition and standoff correlated to the LH-LB. The HV-LB conducted the initial stages of this mission with the LH-LB joining the fight to give slightly additional range.

(9) EUR guard mission results.

(a) The force exchange ratios for the base case and all alternatives are provided in figure 3-10. Red losses are consistent across the alternatives but significantly less for the ACR. Blue losses are also consistent across the alternatives. The majority of these losses were to direct fire. The close terrain of this scenario produced a greater quantity of close range engagements versus the SWA open terrain. The Blue losses of the ACR were extremely high and a direct result of poor helicopter support and lack of advanced technology for the cavalry elements.

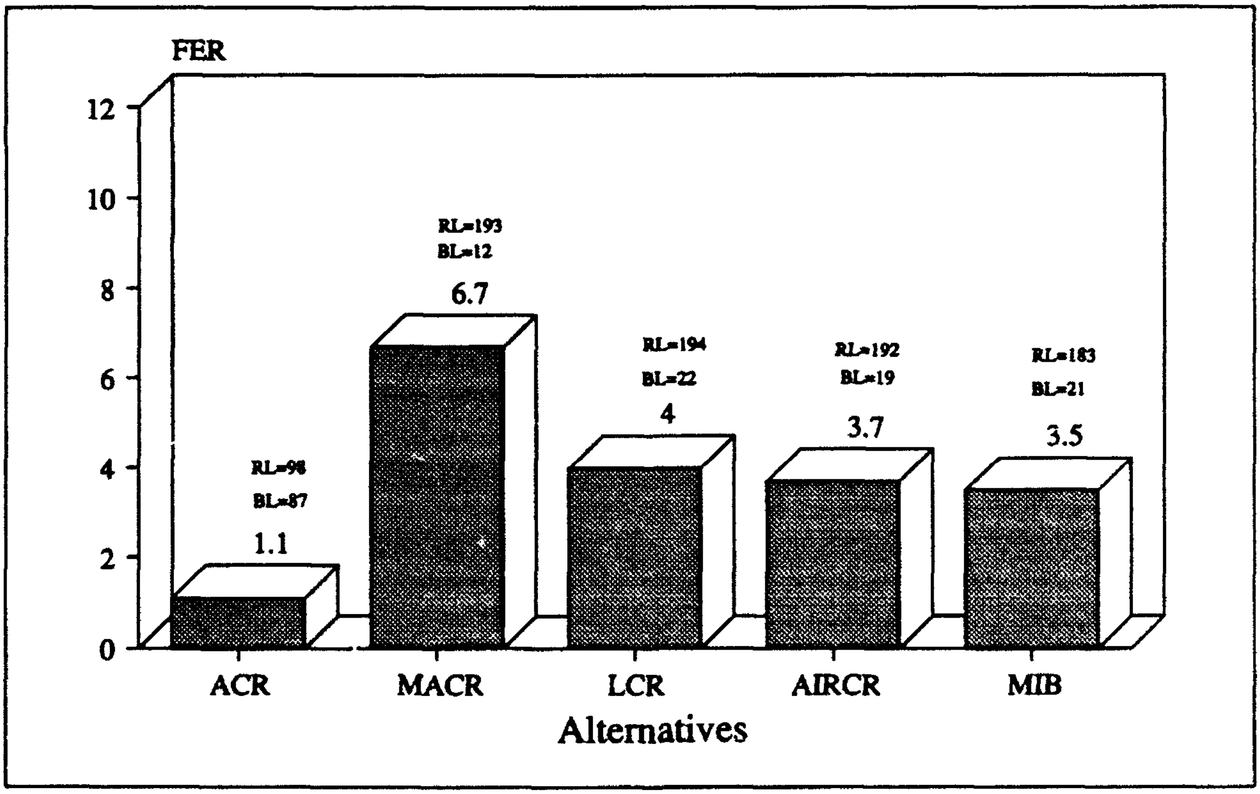


Figure 3-10. Europe force exchange ratio (guard)

(b) The percent contribution by system type is provided in figure 3-11. The terrain of this scenario, in combination with the tactics employed, caused a larger contribution byground systems than in SWA. The MIB, LCR, and AIRCR used the LH-LB for 25 percent contribution across the board. The remaining 75 percent was provided by the ground systems. For the MIB and LCR this was the FSV(C), AGS, and AAWS-M. For the AIRCR this was the HV-LB.

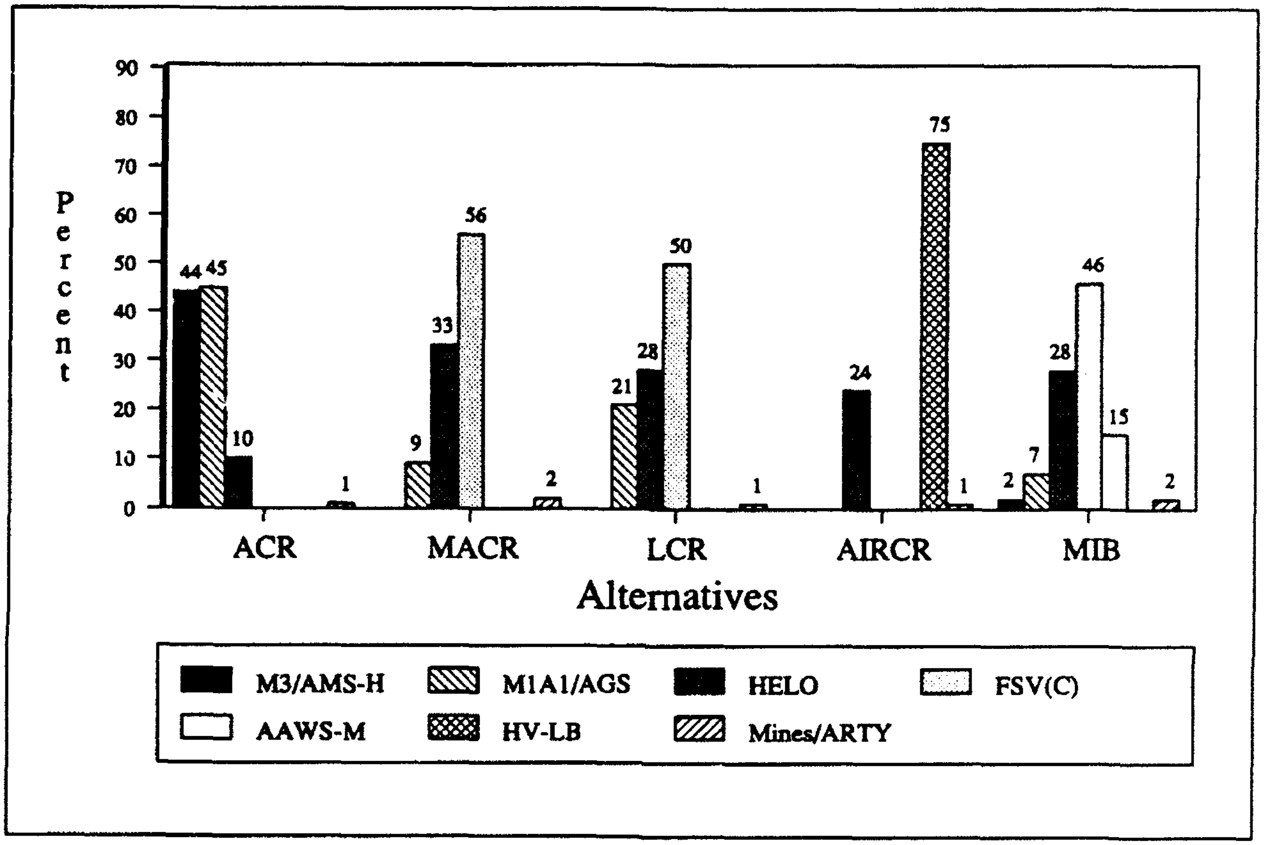


Figure 3-11. Europe percent contribution (guard)

(c) The SER is provided in figure 3-12. The best performer was consistently the FSV(C). It was both extremely lethal and for technical reasons, highly survivable. The LH-LB was also an excellent performer; far less than in SWA, however, because of the difficult line-of-sight problems that exist in Europe. Coupled with the better air defense available to Red, helicopters became both less lethal and more vulnerable in this environment. They were still a powerful and necessary component of all successful alternatives. Two other interesting results are worthy of discussion. First, the M1A1 vs the AGS when viewed in terms of SER. The AGS killed twice as much as the Block III M1A1. It also died twice as much. Hence, the overall performance of the two systems were essentially equal in terms of SER. Secondly, the LB technology on the HMMWV performed as well as that of the air platform. Both could use their longer range missile to effect large standoff range to improve survivability. Their only problem came from Red systems that somehow avoided detection and closed to effective firing ranges.

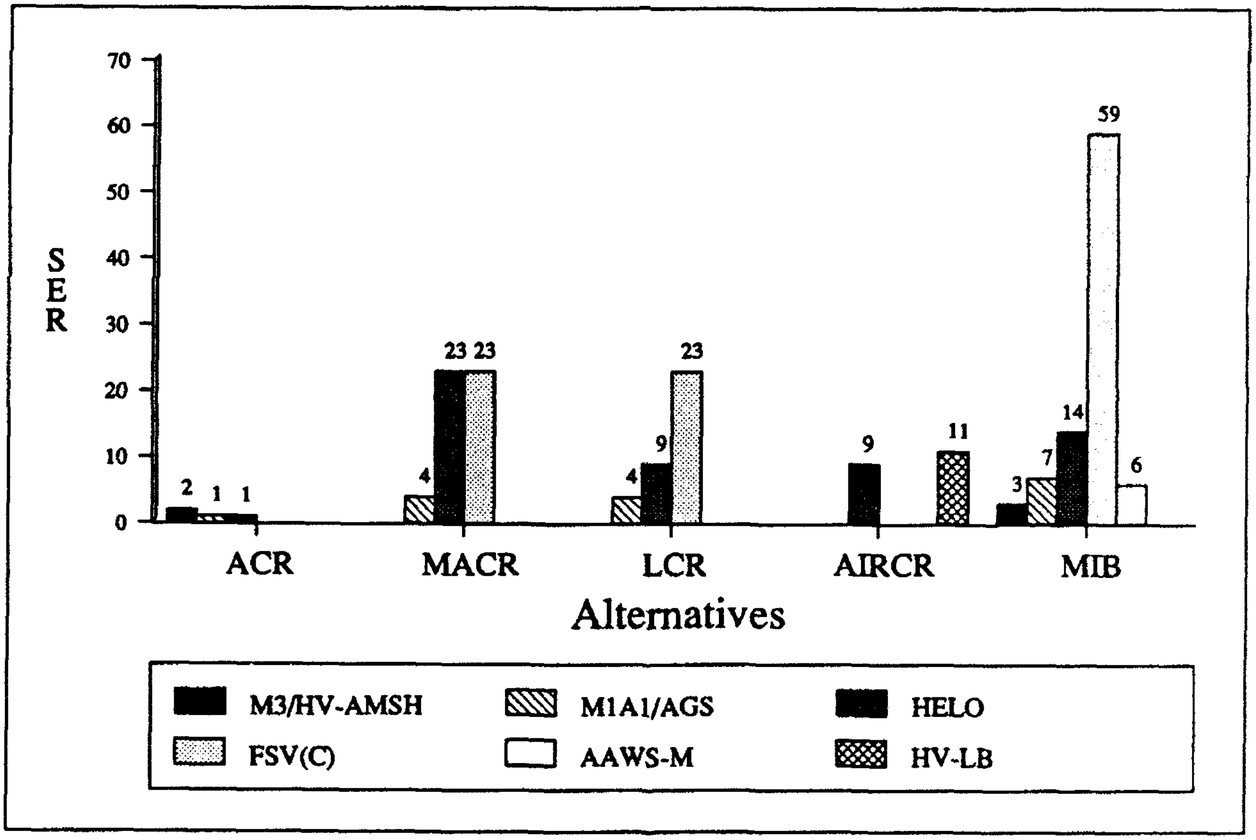


Figure 3-12. Europe SER

(d) Kills per system employed are provided in figure 3-13. The FSV(C), LH-LB, and HV-LB are extremely proficient. Their potential increased by as much as 500 percent over those systems employed in the ACR. Even the AAWS-M is effectively used in this scenario, producing better results than the M1A1 in the ACR. Only the Block III M1A1 and AGS in the MACR and LCR fail to excel. The reasons for this are straightforward. There are more of these systems than any other, and they are tactically employed so as not to engage the enemy unless absolutely necessary. Overall, the systems employed by the light cavalry alternatives appear to be extremely efficient killers that provide the commander with both high tactical flexibility and lethality.

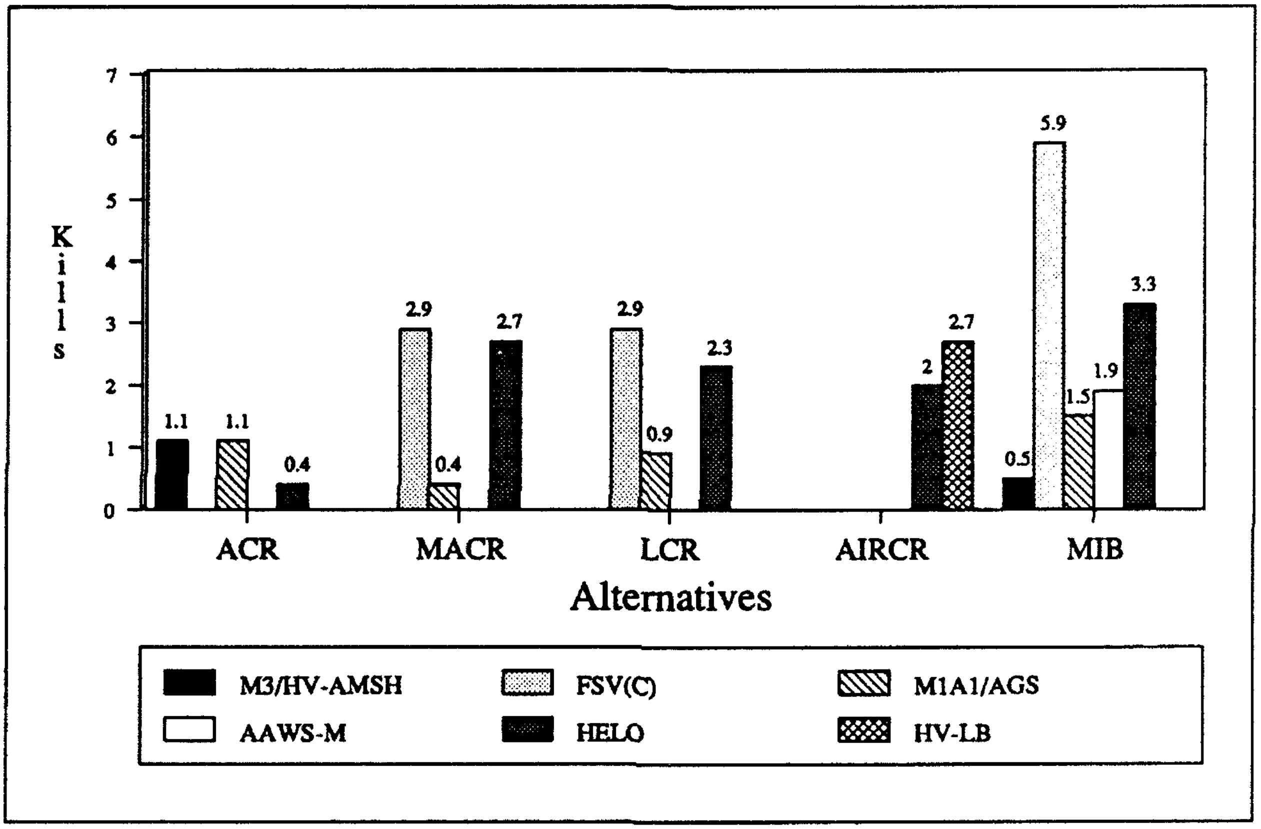


Figure 3-13. Europe kills per system employed

3-2. Resource support requirement.

a. *Logistics findings.*

(1) Mission. To assess the logistic impacts of augmenting an AirLand Operations (ALO) contingency corps with alternative regimental sized units. The contingency corps may or may not contain an ACR, but the ACR will be the base case for this analysis for comparative purposes. The type of augmentation will be either a MACR, a LCR, an AIRCR, or a MIB.

(2) Methodology.

(a) This analysis compared the supply sustainment, maintenance manpower, and CSS force structure requirements (supply, transportation, and maintenance) across all study alternatives in a SWA scenario and provided personnel and force structure impacts to TRAC-WSMR for costing purposes.

(b) The analysis focused on the added support requirements of placing the alternative units into a corps force structure. Internal support requirements were assumed to be adequately addressed in the design of each alternative.

(3) Results. In many respects, with a few quantitative differences, the requirements to support the ACRs and the alternative regiments are very similar.

(a) Maintenance.

1. The ACR has the highest overall requirement for maintenance followed by the AIRCR and the MACR (figure 3-14). The ACR also passes the most maintenance into the corps in the form of GS maintenance. The ACR maintenance requirements are strictly a function of their preponderance of heavy armored equipment compared to the other alternatives. The MACR and AIRCR have lower GS and DS requirements, but the increased flying hours of the LH-LB over its predecessor systems increases the internal unit requirement for maintenance. The AIRCR requires the most aviation unit maintenance (AVUM) support.

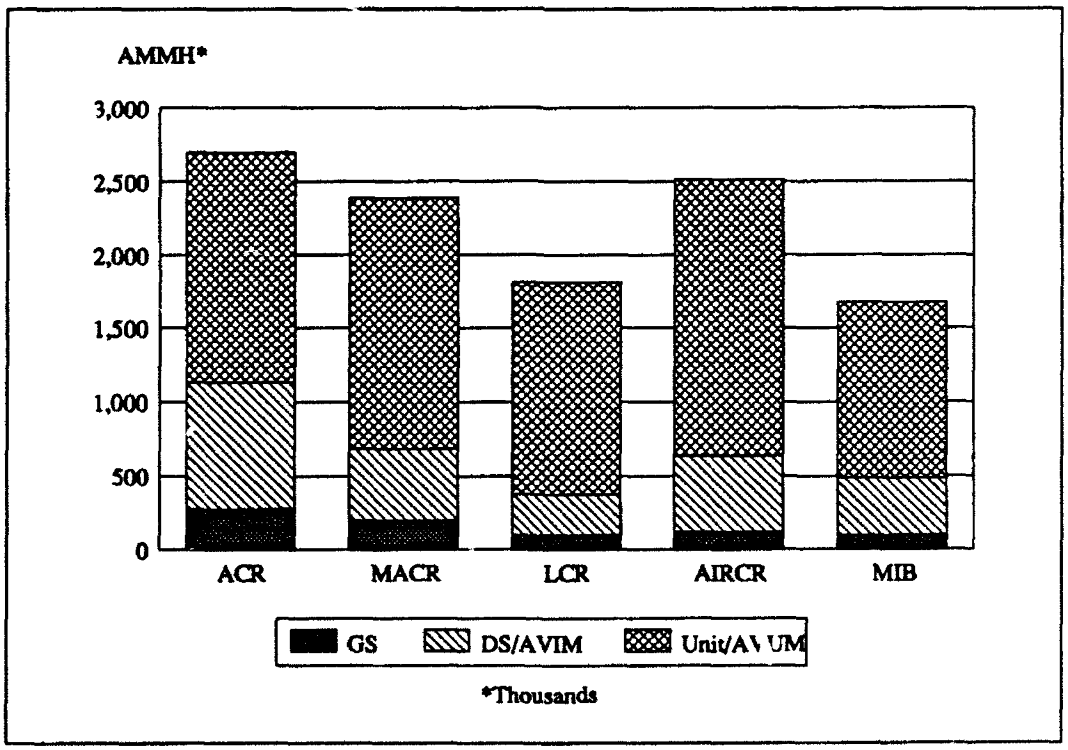


Figure 3-14. AGMC LIA AMMH requirements

2. Among the non-ACR alternatives, the MIB and the LCR generate the lowest requirement for maintenance. The AIRCR has the highest requirement due to its higher density of aircraft.

3. The number of mechanics that the GS AMMHs (shown in figure 3-14) equate to, are shown in figure 3-15. The ACRs are significantly higher than the other regiments. Modernization of the ACR with the introduction of the Armored Systems Modernization (ASM) tank and self-propelled howitzer reduces the DS and GS requirement for mechanical maintenance, fire control, and turret mechanics, but as figure 3-14 shows, increases the unit requirements.

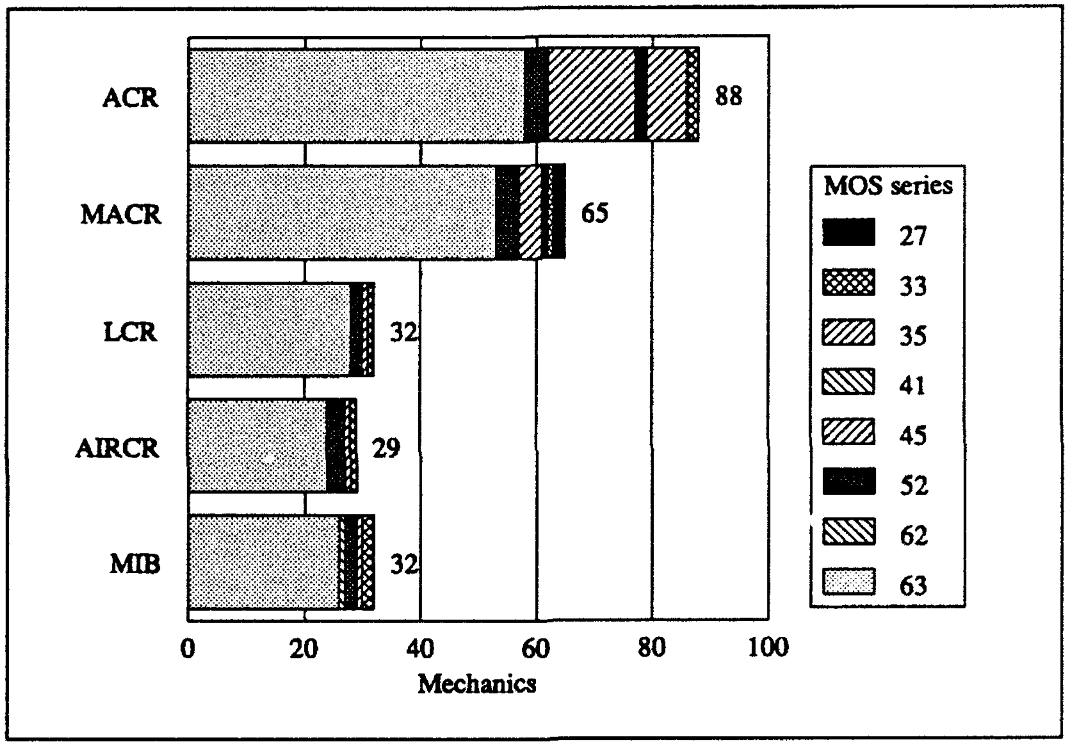


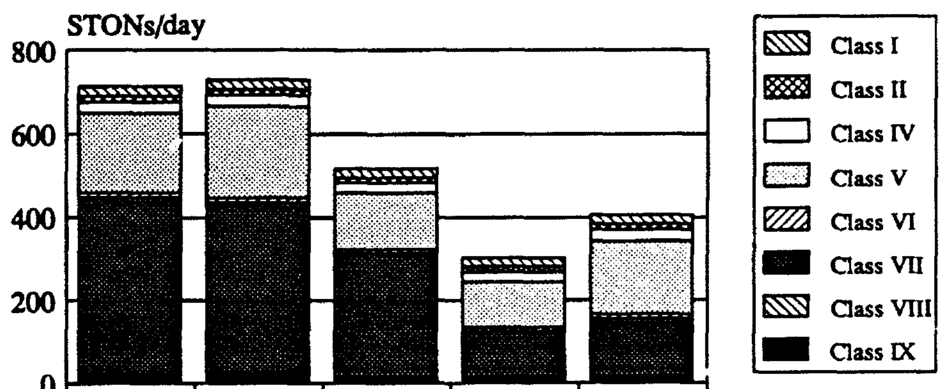
Figure 3-15. AGMC LIA GS mechanic requirements

(b) Supply sustainment. A description of the classes of supply is shown in table 3-7 for reference.

Table 3-7. Classes of supply

Class I	-	Subsistence
Class II	-	Clothing, tools, individual equipment, administrative and housekeeping supplies
Class III	-	Petroleum fuels, oil, and lubricants
Class IV	-	Construction and barrier materials
Class V	-	Ammunition
Class VI	-	Personal demand items
Class VII	-	Major end items
Class VIII	-	Medical supplies
Class IX	-	Repair parts

1. For dry commodities expressed in STONs, the ranking of requirements from lowest to highest is shown in figure 3-16. The requirements consist predominantly of ammunition and major end end items and the results are generally intuitive. Class VII requirements (major end items) are primarily influenced by equipment weight with the AIRCR (the lightest unit) having the lowest requirement, and the ACRs (the heaviest units) having the highest requirement. The class V (ammunition) requirement is driven by the number of howitzer tubes. The MIB and the ACRs have 24 tubes each and all others have 16.

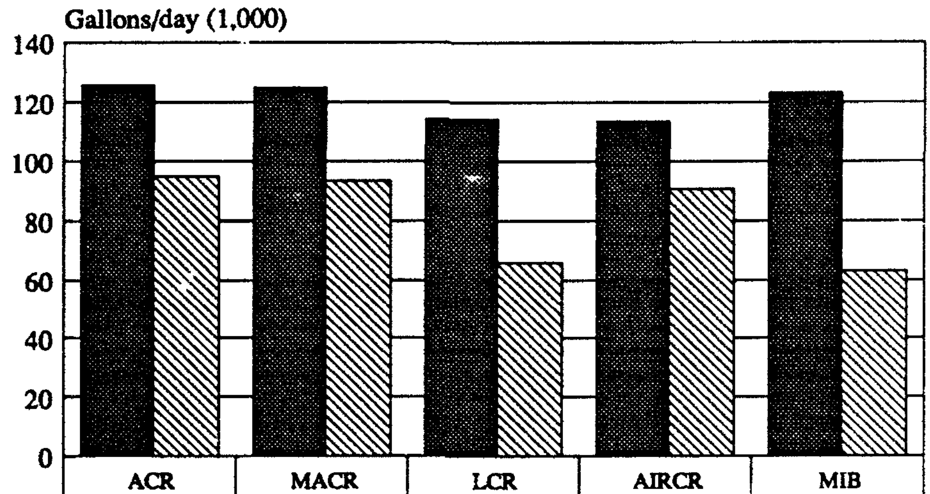


	ACR	MACR	LCR	AIRCR	MIB
Class I	22.2	22	20.1	20	21.7
Class II	14.7	14.6	13.4	13.2	14.5
Class IV	26.7	26.5	24.2	24.1	26.2
Class V	190.4+	216.7+	134.7*	111.4*	177.7+
Class VI	10.7	10.6	9.7	9.7	10.5
Class VII	423.5	414.9	297.2	108.1	139.4
Class VIII	3.8	3.8	3.5	3.5	3.8
Class IX	13.7	12.7	6.4	4.8	5.5

+ 24 tubes
* 16 tubes

Figure 3-16. STON requirements

2. Bulk fuel requirements (figure 3-17) are influenced by two primary factors: the number of aircraft and overall equipment weight. The AIRCR (aircraft) and the ACRs (weight) are almost equivalent in class III consumption for these two reasons.



	ACR	MACR	LCR	AIRCR	MIB
Water	125.7	124.8	114.1	113.6	123.2
Class III	94.9	93.5	65.9	90.7	63.2

Figure 3-17. Liquid requirements

3. Water consumption for this analysis was based on 20 gallons per person/per day and is therefore strictly population driven. Water consumption could increase up to 80 gallons per person/per day without an increased support force structure impact.

(c) Support force structure. The LCR and the MIB have identical support requirements (table 3-8) and are less than the AIRCRs' and the ACRs'. The AIRCR and ACRs have higher support force structure requirements because their higher fuel consumption increases the requirement for petroleum truck companies and associated maintenance.

Table 3-8. Force structure requirements

		STR	ACR	MACR	LCR	AIRCR	MIB
08419L0	Vet det	6	1	1	1	1	1
08498L0	Med det	13	1	1	1	1	1
14413D8	Finance team	19	1	1	1	1	1
27512L0	JAG team	5	1	1	1	1	1
43209L0	Maint Co	200	2	2	1	2	1
43509LG	Wheel rep team	7	4	4	4	4	4
55540LE	Trl Trans Pt	8	2	2	2	2	2
55728L1	Med Trk Co (cargo)	191	1	1	1	1	1
55728L1	Med Trk Co (water)	191	1	1	1	1	1
55728L2	Med Trk Co (petro)	177	2	2	1	2	1
55827L0	TML Svc	361	1	1	1	1	1
42419L0	Repair parts Co	185	0	0	0	0	0
	Total spaces =		1,584		1,207	1,584	1,207

(d) Comparison of alternatives.

1. Discussion. The ACRs are fundamentally different from the other alternatives. They are heavy, powerful, armored units in the true sense of that expression, designed to engage in intense combat with equally capable adversaries. The alternatives are more suited to the contingency reconnaissance and screening roles for which they were designed than for intense combat. Table 3-9 shows the required support quantities in the following four areas:

-- Total internal (unit and DS) AMMH. Since the regiments/brigades generally have the same number of people, a higher internal maintenance requirement means that more organic mechanics are required and the units have a lower "tooth to tail" ratio.

-- External (GS) mechanic requirement. The requirement for mechanics external to the units is a true additional cost. How the requirement would be met in the force structure depends upon the structure of the corps into which the alternatives would be deployed.

-- Supply sustainment requirements. All other things being equal, the lower the average daily requirement, the easier the alternative is to support. Sustainment is divided into dry commodities and class III.

-- Supporting CSS force structure requirements. Similar to the above, the smaller the support slice required, the easier the alternative is to support.

Table 3-9. Summary of alternatives

	ACR	MACR	LCR	AIRCR	MIB
AMMH* (unit & DS)	2,419	2,190	1,712	2,391	1,574
GS Mechanics	88	65	32	29	32
Sustainment					
Class III (gal/day)*	95	94	66	91	63
Dry (STONS/day)	706	722	509	295	399
CSS Force Strc	1,584	1,584	1,207	1,584	1,207
* thousands					

2. The MIB, followed by the LCR, are the preferred alternatives from a pure logistics standpoint. The AIRCR is rated third. The ACR and MACR require the most logistics support.

3. The MACR was created by upgrading equipment without redesigning the organic support structure. Introduction of the LH-LB increases the requirement for aviation mechanics by 266. At a minimum, this change alone would require a redesign of the aviation maintenance structure.

b. *Costing findings.*

(1) Decision cost analysis results.

(a) The decision cost excludes MPA. The impact of MPA assets on cost ranking were considered for sensitivity analyses and are addressed later.

(b) Detailed spreadsheets for the base case, the four alternatives, and the LIA can be found in appendix G, annex A. Table 3-10 presents total costs for the ACR, MACR, LCR, AIRCR, and MIB. These are building blocks for the 20-year decision costs.

Table 3-10. AGMC force costs (FY92) (millions)

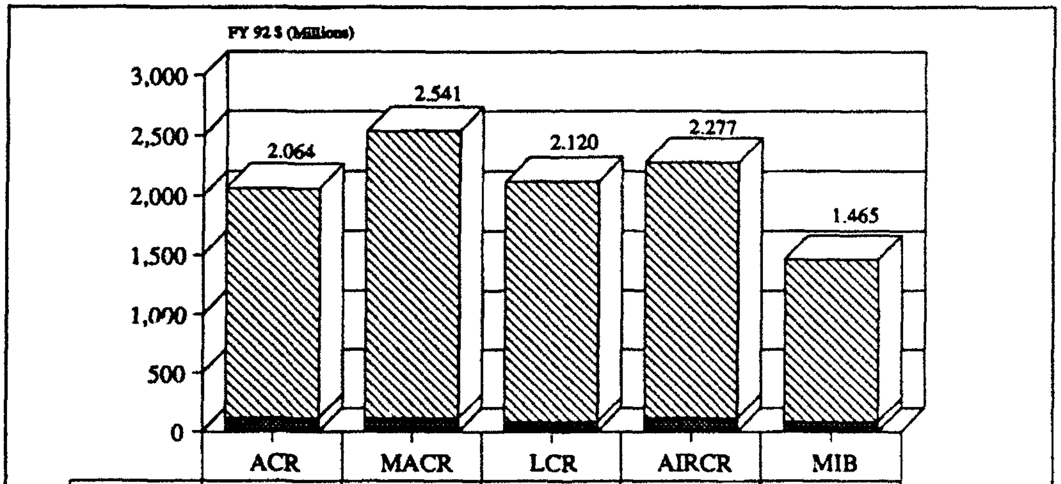
Force	Nonrecurring	Recurring OPTEMPO	Total
ACR	$ 986	$961	$1,947
MACR	1,886	538	2,424
LCR	1,563	472	2,035
AIRCR	1,607	553	2,160
MIB	942	438	1,380

Table 3-11 presents costs of the CSS units as specified by TRAC-Fort Lee, VA (TRAC-LEE).

Table 3-11. LIA additional costs (FY92) (millions)

Force	Nonrecurring	Recurring OPTEMPO	Total
ACR	$73	$44	$117
MACR	73	44	117
LCR	53	31	85
AIRCR	73	44	117
MIB	53	31	85

(c) After collecting and totaling all of the equipment costs for the study forces, including the CSS units for each, the total 20-year decision costs (nonrecurring plus 20 years of recurring costs) comparisons are presented in figure 3-18.



	ACR	MACR	LCR	AIRCR	MIB
Unit	1,947	2,424	2,035	2,160	1,380
Log force	117	117	85	117	85

Figure 3-18. Decision cost comparisons

(d) The ranking of the base case and alternatives are presented in table 3-12 using the decision costs only (personnel excluded). The cost of the MIB force structure is less than the other study forces, followed, in order, by the rest of the forces.

Table 3-12. Force structure rankings

Rankings	FY92 (millions) decision cost	Percent increase in cost
MIB	$1,465	--
ACR	2,064	41%
LCR	2,120	45%
AIRCR	2,277	55%
MACR	2,541	73%

3-3. Deployment. This analysis examined the air deployment of five force designs; an ACR, a MACR, and three alternative designs (LCR, AIRCR, and MIB). Force deployment for this analysis was to a SWA area of operations with forces and air resources in the year 2004. The analysis used airlift sortie requirements that would be needed to deploy each of the forces using C-5, C-17, and C-141 air force cargo aircraft from the Military Airlift Command (MAC).

a. *Methodology.*

(1) AALPS was used to determine the number of sorties of a specific aircraft type that was needed to deploy a specific force. A spreadsheet, developed by the Military Airlift Command Liaison Office (MACLO) at Fort Leavenworth, was then used to determine airlift closure times for each of the force alternatives based upon the results from AALPS.

(2) Excursions to the basic methodology consisted of the self-deployment of helicopters and the determining of closure times for the forces.

b. *Assumptions.*

(1) The term "forces" refers to items and personnel as listed in a TOE that would have weight or cubic capacity for aircraft loading consideration.

(2) The term "supplies" refers to dry cargo and ammunition requirements as determined in the LIA, (see appendix G).

(3) Force closure times include the loading, flight time, and unloading of aircraft for a generic flight plan from Fort Hood, TX, to Dhahran, Saudi Arabia.

c. *Results.* Force deployment was considered for three categories: forces only, forces without helicopters, and forces and supplies. The figures in this section consist of four grouped

columns of bar graphs. The two grouped columns labeled C-5 and C-17 consider only the individual aircraft used for deployment. The grouped columns labeled C-141/C-5 and C-141/ C-17 used both aircraft types for deployment. In the latter cases, the C-5 or C-17 was used only for specific equipment that had height or weight limitations and could not be loaded on a C-141.

(1) Figure 3-19 shows that it is impractical to deploy the ACR and the MACR by air due to the existence of heavy equipment, specifically, tanks in the force structure. Additionally, it shows that there is relatively no significant difference in the deployment of the three alternatives.

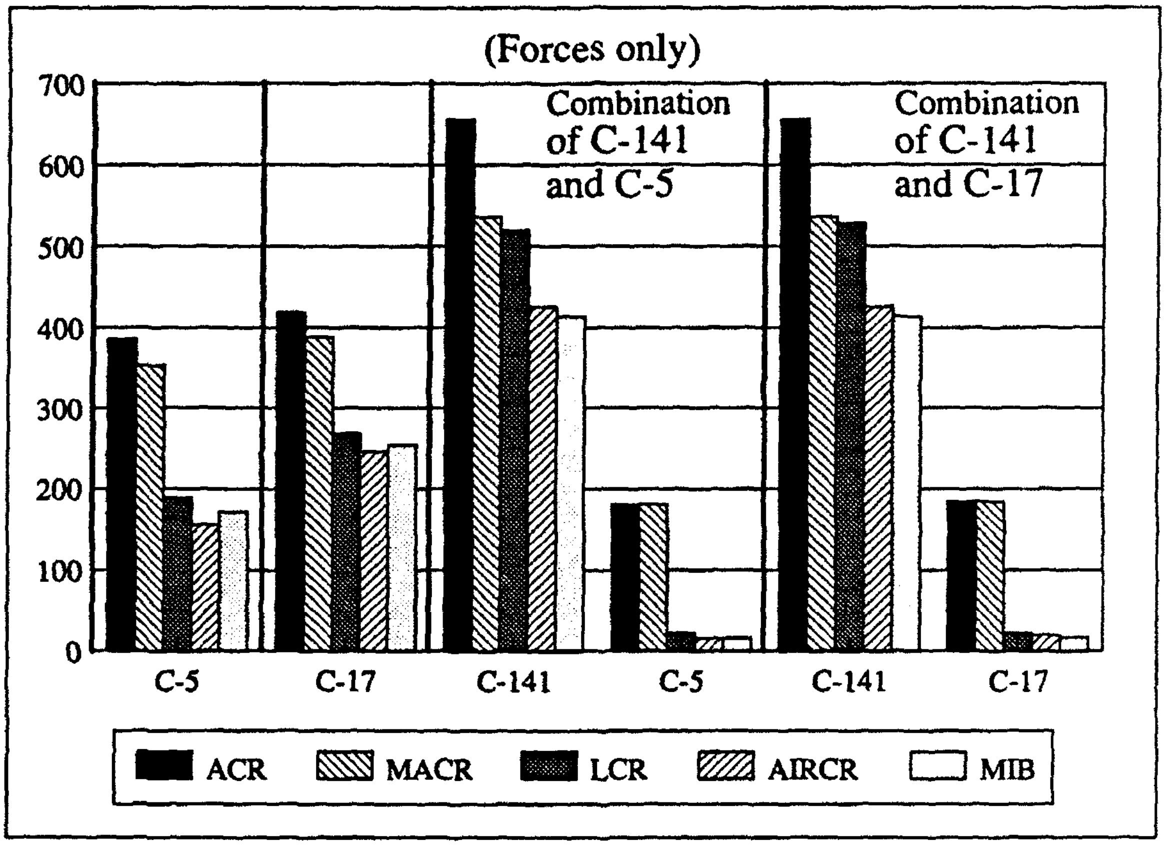


Figure 3-19. Aircraft sorties (forces only)

(2) The self-deployment of helicopters, as shown in figure 3-20, did not appreciably improve the deployment of any of the forces. Figure 3-21 shows that sustaining the forces had no real impact on the deployment of the force designs.

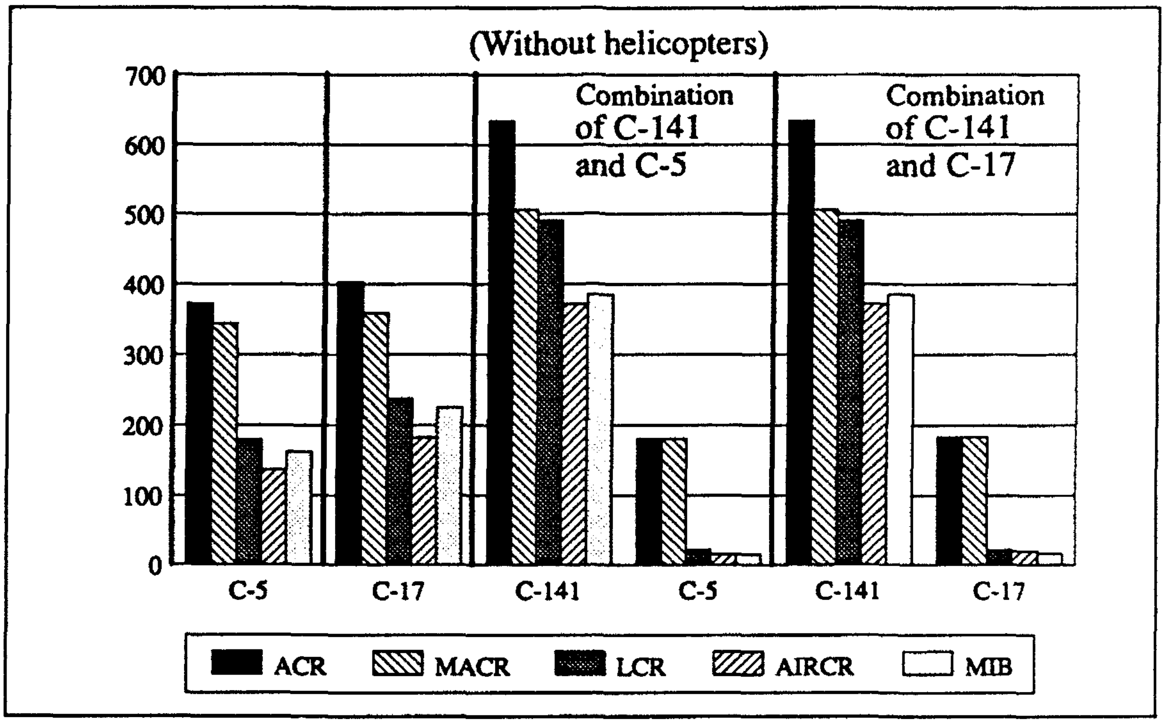


Figure 3-20. Aircraft sorties (without helicopters)

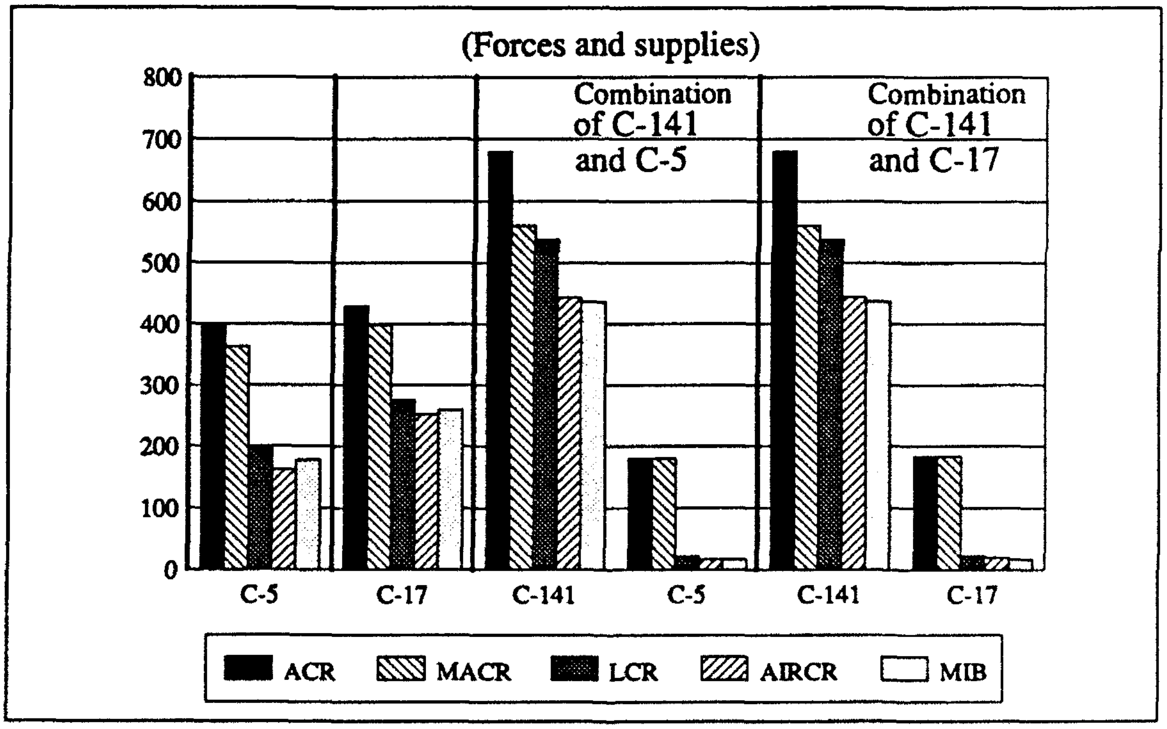


Figure 3-21. Aircraft sorties (forces and supplies)

(3) The force closure times in figure 3-22, show all three alternatives relatively close using the C-5s or C-17s. There is a significant improvement of closure times for deploying the AIRCR and the MIB alternatives using the C-141 combinations.

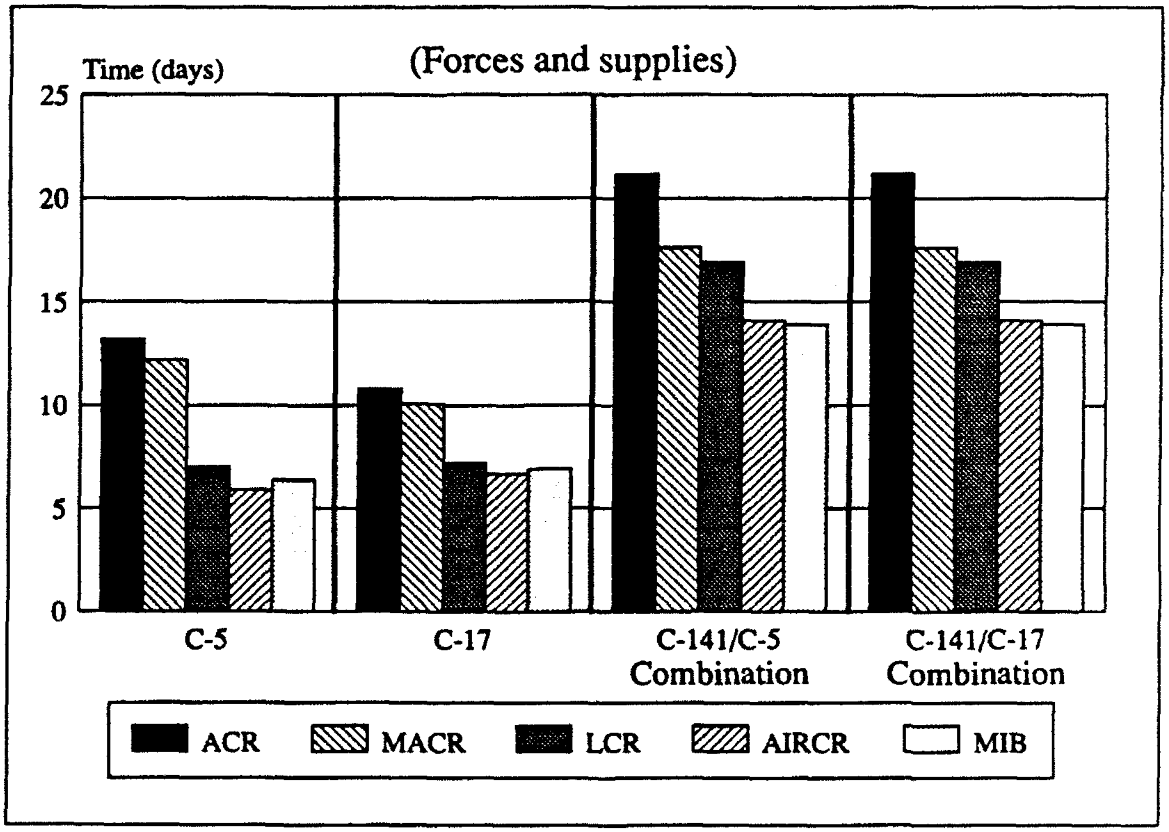
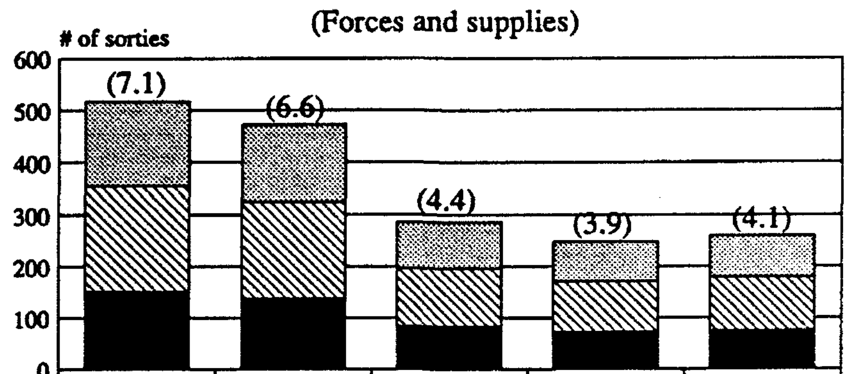


Figure 3-22. Closure times (forces and supplies)

(4) Using all aircraft available determines the optimum closure time to deploy the forces, and figure 3-23 again shows that there is relatively no significant difference in the deployment of the three alternatives. As all aircraft would not be available for deployment, figure 3-24 shows the parametric ranging of aircraft availability resulting in a larger delta for the deployment times between the alternatives.



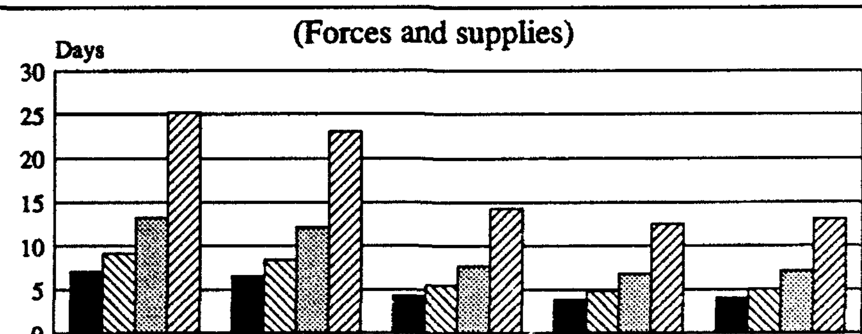
	ACR	MACR	LCR	AIRCR	MIB
C-141	162	148	90	78	81
C-17	204	186	113	98	103
C-5	151	138	84	73	76

Available aircraft: 83 C-5, 78 C-17, 100 C-141

C-5 C-17 C-141

( ) - Days for deployment

Figure 3-23. Optimum closure times (forces and supplies)



	ACR	MACR	LCR	AIRCR	MIB
100%	7.12	6.58	4.37	3.91	4.05
75%	9.14	8.43	5.5	4.86	5.05
50%	13.23	12.18	7.72	6.81	7.1
25%	25.16	23.06	14.29	12.52	13.08

% of available aircraft

100% 75% 50% 25%

Deployment time in days

Figure 3-24. Feasible closure times (forces and supplies)

(5) For this entire analysis, passengers (PAX) were included as equipment and distributed throughout the aircraft sorties. Under normal conditions PAX would deploy on civilian reserve air fleet aircraft such as a 747, etc. Removing the PAX from the equipment lists did not change the sortie count.

3-4. Mobility. This analysis examined the organic and tactical mobility of the five force designs; an ACR, a MACR, and three alternative designs (LCR, AIRCR, and MIB).

a. *Methodology.*

(1) The mobility analysis consisted of examining the quantity and types of vehicles organic to each of the five force structure designs and determining the weight and cubic feet capacity of the vehicles and the requirements needed to be loaded on the vehicles. The requirements include equipment as being from TOE, personnel, CTA, and supplies. Supplies were determined in the LIA process, (see appendix G).

(2) The tactical mobility analysis consisted of comparing the capabilities of vehicles in each of the force designs.

(3) An excursion to the analysis included examining the extended logistical capability that each of the forces could maintain.

b. *Results.*

(1) The comparison of vehicle capacity to vehicle requirements in figures 3-25 and 3-26 shows that in all force designs there is an excess of vehicle capacity to requirements for both weight and cubic feet, and therefore, they are all 100 percent mobile with organic resources. Normally, vehicles would cube-out before weighing-out. As shown here, there is a large excess of weight capacity for the ACR and MACR, but very little excess capacity of cubic feet.

(2) The three alternative force structures did not contain any of the family of medium tactical vehicles that would be in the field in the year 2004. The effect of these vehicles would improve force mobility by allowing more personnel to be located in the cab of the vehicle, thus, allowing for more supplies to be carried as cargo in the vehicles.

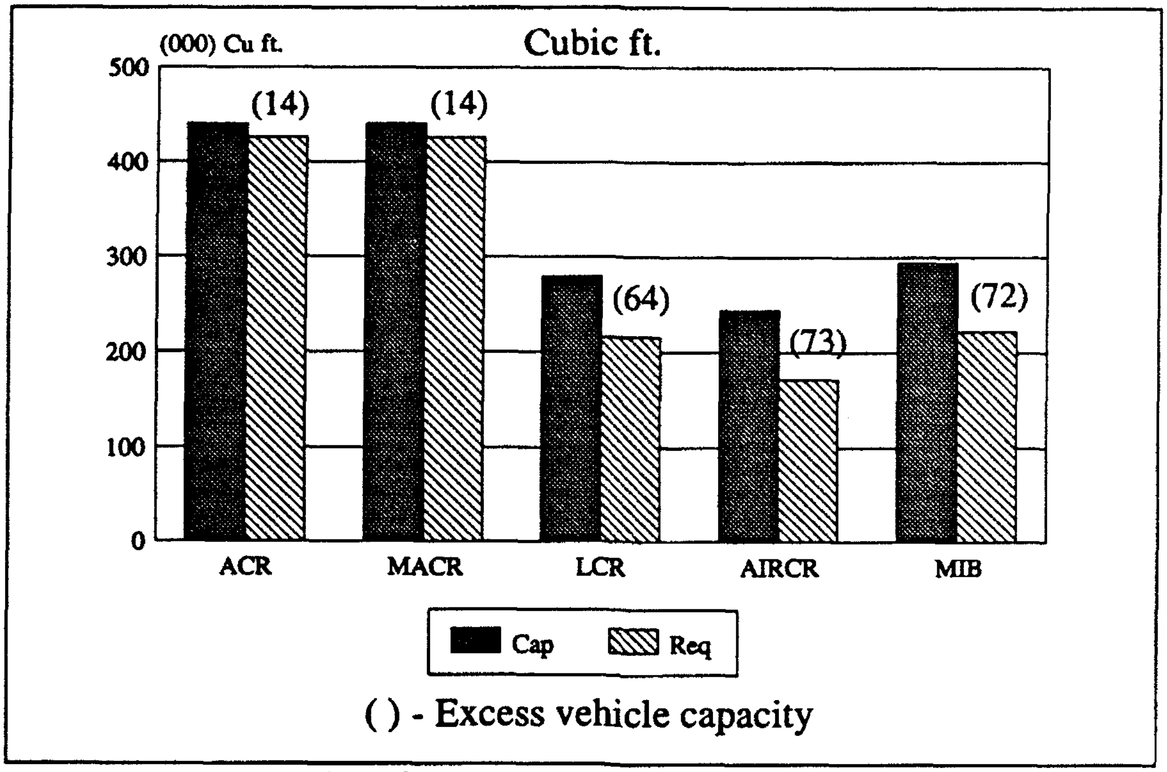


Figure 3-25. Organic capacity (cubic feet)

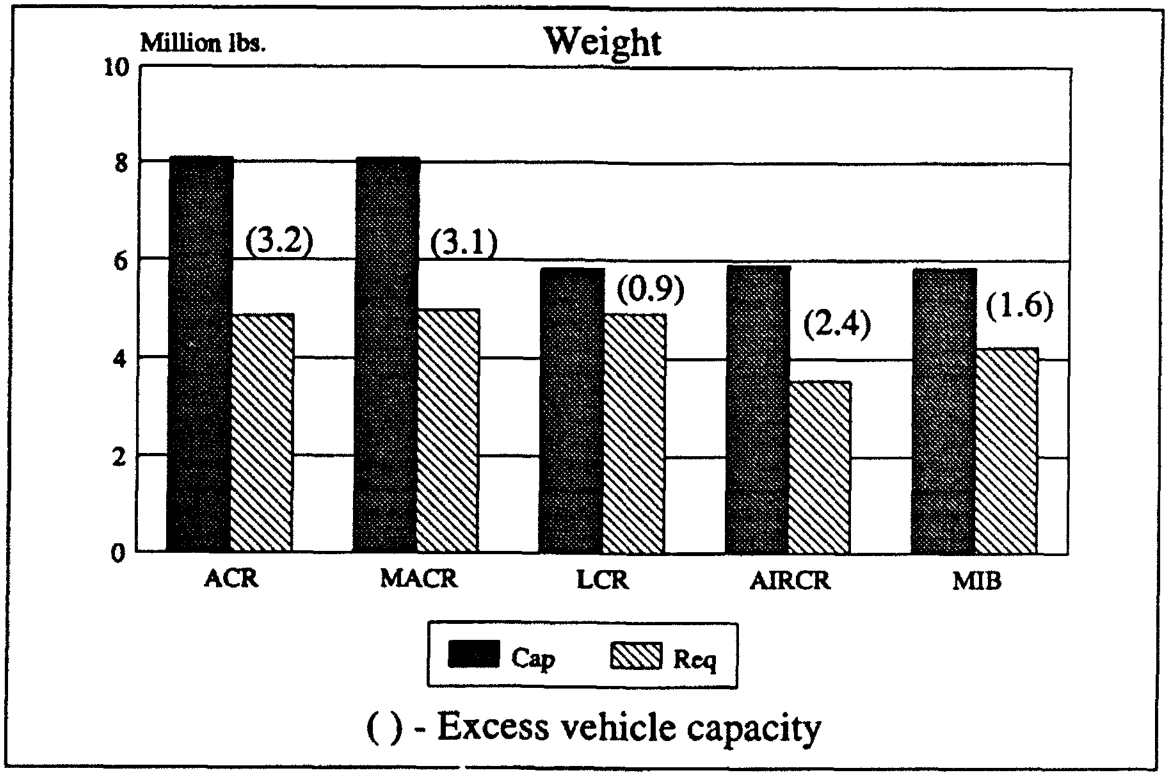


Figure 3-26. Organic capacity (weight)

(3) Examination of the vehicle capabilities proved that each of the three alternatives have similar wheeled vehicles and therefore, have similar tactical mobility.

(4) Results of the excursion that analyzed the extended logistical capability for each of the alternatives are shown in table 3-13.

Table 3-13. Extended capabilities

Ground: Trucks assumed to be available for diesel fuel. Air: JP4 fuel (in thousands of gallons).					
	ACR	MACR	LCR	AIRCR	MIB
CONS/FARP/24 hours	35	21	23	23	13.5
CAP/FARP	30	15	10	15	7.5
CONS/CAP	1.2	1.4	2.3	1.5	1.8
FARPs are within 1.5 driving hours to a FSB.					
Note: AV has 3 FARPs while AR and IN have 2 FARPs.					

The terms "CONS/FARP/24 HRS" refers to the fuel consumption per forward area refueling point (FARP) for a 24-hour period, "CAP/FARP" refers to the fuel capacity derived from the number of heavy expanded mobility tactical trucks (HEMTTs) per FARP, and "CONS/CAP" refers to the fuel consumption with respect to the fuel capacity which represents the number of round trips, from FARP to the nearest forward support battalion (FSB), the vehicles would need to perform in order to support the aviation operations for a 24-hour period. This shows that all alternatives had enough capability to support their aviation operations.

AIR GROUND MOTORIZED CAVALRY EVALUATION

CHAPTER 4

CONCLUSIONS AND RECOMMENDATIONS

4-1. Conclusions.

a. The comparison among the alternatives shows very little difference in the areas of deployability, mobility, costing, and logistics. Similarities also exist in the fact that all alternatives were successful in all missions evaluated. The true value of this comparison is not to determine which alternative is most successful but to outline those strengths and weaknesses identified. This information can be used to influence the final light cavalry design.

b. The analysis conducted did not determine strengths or weaknesses based upon internal structure of the organization, but rather, on the performance of the specific systems contained within the organization. For example, the addition of a recon squadron in the LCR was useful, but the AIRCR without the recon squadron was equally successful. Instead of the recon squadron being the driver, success really depended upon the characteristics of the FSV(S) which made up the recon squadron. In lieu of this system capability, the AIRCR used the LH-LB to perform the same missions without similar organizational structures. Strengths and weaknesses will be presented in this light.

c. The LCR had the best control of deep fires. This is based upon the ability of the FSV(S) to give early and continuous detections which directly influences the deep fires. The value of this system is attributed to advanced technology and its position on the battlefield. The LCR also contained sufficient numbers of LH-LB for the advantage of long-range antiarmor lethality. The mixture of AGS and FSV(C) gives the LCR ground system flexibility to perform in varied terrains. The LCR included a good mixture of systems to deal with varied threats and terrain. These characteristics are summarized in table 4-1.

d. The AIRCR was based on one technology--longbow. The LH-LB was a valuable asset for control of deep fires, and long-range antiarmor lethality. The HV-LB gave the design the flexibility of a ground system when restrictions effect the LH-LB. The HV-LB had the advantage over other ground systems by having an extended range and an effective antihelicopter capability. The aviation design is only limited by a one weapon approach which is logistically intensive and overlooks the close fight. These characteristics are summarized in table 4-2.

Table 4-1. LCR strengths and weaknesses

Strengths
- The FSV(C) provides the most sustained and effective detection stream for deep fires.
- The FSV(C) provides survivability (advanced technology), target acquisition (battlefield positioning), and lethality (missile).
- The LH-LB provides great eyes and lethality.
- The AGS provides excellent long-range fires with STAFF and good protection against dismounted infantry.
- The mix of weapons provides reasonable tactical flexibility.
Weaknesses
- The FSV(C) lacks defense against dismounted infantry, are vulnerable to artillery, and cannot survive a close fight.
- AGS must have STAFF to be effective in Europe.

Table 4-2. AIRCR strength and weaknesses

Strengths
- The LH-LB provides the best counterrecon capability.
- The LH-LB provides great eyes and lethality.
- The HV-LB provides excellent long-range antiarmor lethality and contributes to antihelicopter defense.
Weaknesses
- One technology dependent.
- Lack of close battle capability.

e. The MIB is much like the LCR in strengths. The FSV(S) and the LH-LB provide information for control of deep fires and offer long-range antiarmor capability. The major difference between the MIB and LCR is the quantity of systems. The MIB simply cannot cover the same amount of terrain to the depth that the LCR can. The design has the flexibility of the AGS and FSV(C) as does the armor with an added capability of dismounted infantry. Close terrain restrictions proved the dismount a valuable asset and an added dimension of flexibility in the MIB. These characteristics are summarized in table 4-3.

Table 4-3. MIB strengths and weaknesses

Strengths
- The FSV(C) provides survivability (advanced technology), target acquisition (battlefield positioning), and lethality (missile).
- The LH-LB provides great eyes and lethality.
- The AGS provides excellent long-range fires with STAFF and good protection against dismounted infantry.
- Dismount elements provide capability in close terrain.
Weaknesses
- FSV(C) lacks defense against dismounted infantry, are vulnerable to artillery, and cannot survive a close fight.
- AGS must have STAFF to be effective in Europe.
- Vulnerability of dismount.
- Limited contribution by AT-4.

f. Considering the strengths and weaknesses across all alternatives, scenarios, and areas of analysis, the following conclusions are provided:

(1) The corps analysis established the need for the LCR to contain both a reconnaissance squadron and a regimental aviation squadron. The recon squadron must be equipped with systems of similar capability to that of the FSV(S). The ability of this organizational unit to go deep and provide sustained and effective detection streams was unmatched. The added capability of a regimental aviation squadron with the counterrecon capabilities of the LH-LB makes this regiment efficient and effective as it performs with corps assets.

(2) The high-resolution analysis established the need for a light cavalry squadron which contains systems capable of scout functions and overwatch capability. The design most effective included the FSV(C) as the scout vehicle and the AGS for overwatch. The FSV(C) used enhanced technology to remain unobserved and is equipped with a missile capability. The AGS offers a slightly more protected platform as it provides overwatch for withdrawal of the FSV(C). The teamwork of these systems was successful in both open and close terrain.

(3) The high-resolution work reconfirmed the conclusion of the corps effort which supports the necessity for a regimental aviation squadron. The size of the aviation assets was evaluated by a ranging which occurred naturally within the proponent designs. The MIB had 25 LH-LB, the LCR had 53, and the AIRCR had 74. For the missions and terrains evaluated, the MIB had an insufficient number. The AIRCR had enough to enable them to complete the mission exclusively with LH-LB. The LCR used their LH-LB along with their ground systems and were successful. Based on the uncertainty of relying on only one system, the appropriate quantity is approximately 50 LH-LB.

(4) The final conclusion from the Janus work is support of the requirement for dismounted infantry. The close terrain of Europe proved a valuable test for dismounts. In the tactics of the MIB in Europe, the dismounts were used forward on ambush routes. Equipped with AAWS-M they proved effective at destroying enemy lead vehicles. In even closer terrain which forbids vehicles, their value would be even more enhanced. It is an added flexibility for the regiment.

4-2. Recommendations. The recommendation of the study is that the strengths and weaknesses of the designs previously stated in the conclusions be considered in the design of the light cavalry. CAC-CD has the mission of incorporating both the analytic conclusions with their own assessment of unquantifiable parameters in the design process. The strengths determined by this analysis and the information provided in those areas where differences were not discerned should provide the basis of this design.

APPENDIX A

HISTORICAL DOCUMENTATION FOR AIR GROUND MOTORIZED CAVALRY EVALUATION

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APPENDIX A

ANNEX I

DEPARTMENT OF THE ARMY TASKER

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SGS-----	USDR----	3510----	TSC/DOI---
IDEV---	DCSRM----	SSO-----	HANDET---
CGSC-----	FAO----	CID-----	THREATS--
TNG------	AG------	9020----	SASO-----
GCDR-----	PAO-----	MFODAC---	COMSEC---
TRAC-----	SJA-----	OFNTAC---	TCC/MRH---

CGSC		
TNG		
TRAC		✓
COFS		
CSM		
CG		

PTTUZYUW RUEADWD6053 2491257-UUUU--RUWTFHA.
ZNR UUUUU
P 061217Z SEP 91
FM HQDA WASHINGTON DC//DAMO-ZA//
TO RUCLAIA/CDRTRADOC FT MONROE VA//ATCG//
RUWTFHA/CDRUSACAC FT LEAVENWORTH KS//ATZL-CG//
INFO RUFFKKY/CDRUSAARMC FT KNOX KY//ATZK-CG//
RUCLDNA/CDRUSAICS FT BENNING GA//ATSH-C//
RUCLEUA/CDRUSAAVNC FT RUCKER AL//ATZQ-CG//
BT
UNCLAS
PERSONAL FOR GEN FRANKS, CDR TRADOC; LTG SHOFFNER, CDRUSACAC; INFO FOR MG FOLEY, CDR USAARMC; MG CAVEZZA, ~~CDR USAICS;~~ MG ROBINSON, CDR USAAVNC
FROM LTG SPEAY, DCSOPS, HQDA
SUBJECT: LIGHT CAVALRY REGIMENT
1. EMERGING OBSERVATIONS AND LESSONS LEARNED FROM OPERATION DESERT STORM HIGHLIGHT THE NEED FOR A REGIMENTAL SIZED FORCE TO PERFORM RECONNAISSANCE, SECURITY, AND ECONOMY OF FORCE MISSIONS FOR THE CONTINGENCY CORPS.
2. FORCE STRUCTURE DECISIONS FOR BOTH THE NEAR AND LONG TERM DICTATE BOTH A THOROUGH AND TIMELY EVALUATION OF THIS CONCEPT. ACCORDINGLY,

PAGE 02 RUEADWD6053 UNCLAS
IN CONJUNCTION WITH ONGOING DESIGN EFFORTS FOR THE DIVISION CAVALRY SQUADRON, TRADOC IS TASKED TO DESIGN AND ANALYZE ALTERNATIVES FOR A LIGHT CAVALRY REGIMENT. DESIGN PARAMETERS ARE:
A. APPROPRIATE MIX OF AIR/GROUND FORCES.
B. RAPID AIR DEPLOYABILITY VIA C141/C17.
C. GLOBAL UTILITY-CAPABLE OF OPERATIONS OVER FULL CONFLICT SPECTRUM.
D. SELF CONTAINED MAINT/SUPPLY CAPABILITY.
E. EMPLOYMENT/DEPLOYMENT IN SELF SUSTAINING ENTITIES OF LESS THAN REGIMENTAL SIZE.
F. 100% MOBILITY WITH ORGANIC RESOURCES AND EXCEPTIONAL OFF ROAD TACTICAL MOBILITY.
G. 24 HOUR ALL WEATHER OPERATIONS CAPABILITY.
H. ABILITY TO EMPLOY AND COORDINATE ORGANIC/DS/GS/REINFORCING LONG RANGE ARTILLERY AND ATK FIRES.
I. CAPABILITY OF PROVIDING HUMINT VERIFICATION OF INTELLIGENCE

DEVELOPED BY TECHNOLOGICAL MEANS.
3. DISCUSSIONS AT ACTION OFFICER LEVEL INDICATE THAT EFFORT ON THE LIGHT CAVALRY REGIMENT DESIGN IS ALREADY UNDER WAY. IN VIEW OF POSSIBLE IMPACTS ON NEAR TERM FORCE STRUCTURE DECISIONS, TRADOC IS TASKED TO PROVIDE ANALYSIS RESULTS AND RECOMMENDED OBJECTIVE LIGHT

CAVALRY REGIMENT DESIGN TO HQDA, ATTN: DAMO-FDF, NLT 30 OCT 91.
4. VERY RESPECTFULLY, RINNIF.
BT
#6053

NNNN

APPENDIX A

ANNEX II

ANALYTICAL SUPPORT PLAN FOR AIR GROUND

MOTORIZED CAVALRY EVALUATION

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TRADOC Analysis Command-Operations Analysis Center
Studies Directorate
Fort Leavenworth, KS 66027

ANALYTICAL SUPPORT PLAN FOR AIR GROUND MOTORIZED CAVALRY (AGMC) EVALUATION

by

LTC Robert Spencer
CPT Peter Tabacchi
Pat Doherty
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Distribution statement:

Approved for public release;
Distribution is unlimited

TABLE OF CONTENTS

ANALYTICAL SUPPORT PLAN
FOR
AIR GROUND MOTORIZED CAVALRY EVALUATION

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1. **Purpose**. The purpose of this analysis plan is to outline the analytical support that the TRADOC Analysis Command (TRAC) will be providing to the Combined Arms Command-Combat Developments (CAC-CD), the study sponsor, for the Air Ground Motorized Cavalry (AGMC) evaluation.

2. **Scope**.

a. Limitations.

(1) Only three proposed alternatives will be evaluated for a corps-level reconnaissance and security force. The three alternative force designs are:

(a) Air cavalry regiment. [Proposed by the Aviation School (appendix 2)].

(b) Light cavalry regiment. [Proposed by the Armor School (appendix 3)].

(c) Motorized infantry brigade. [Proposed by the Infantry School (appendix 4)].

(2) The analysis will only address those issues identified in the request for support (appendix 5).

b. Assumptions.

(1) System definitions will be available in sufficient detail for evaluation purposes.

(2) Threat doctrine, equipment, and force structure projections through 2004 are accurate.

(3) Blue doctrine and equipment projections through 2004 are accurate.

(4) Approved surrogate data will be available to be substituted for identified data deficiencies.

(5) Cost data required will be available from Army Material Command sources for the equipment specified for study and will not require extensive research and modifications.

(6) Force cost data will be complete and available from The Army Force Cost System (TAFCS) in time to support the study.

(7) The warfight represented in the CAA DESERT SHIELD SWA attack scenario will be appropriate for the purposes of the Logistics Impact Analysis (LIA).

(8) The basic structure and support relationships established for corps units in the base case will remain the same for the alternatives.

(9) All necessary data and support to run the Force Analysis Simulation of Theater Administrative and Logistic Support (FASTALS) model will be available when required.

(10) SRCs [AOE tables of organizational equipment (TOEs)] developed for AirLand Battle (ALB) can be used in an ALB-F study.

(11) Supply requirements based on Army planning factors are representative of supply requirements.

(12) Maintenance requirements based on Army (MARC) maintenance data base information are representative of maintenance requirements.

(13) The leader military occupational specialty (MOS) used in FASTALS are representative of maintenance repairer types.

c. Constraints.

(1) The request for support for this evaluation (appendix 5) stated that the priorities for the scenarios were Southwest Asia (SWA), Latin America (LATAM), and Europe (EUR). The availability of SWA and LATAM scenarios, which are conducive to evaluating cavalry operations, will be a constraint of this evaluation. As a result of the low priority for using European scenarios, they will not be used.

(a) Low-resolution scenarios (LRS). No certified SWA or LATAM scenarios currently exist for evaluating cavalry missions in the Corps Battle Analyzer (CORBAN) model. A low-resolution scenario, LRS AGMC, is currently under development. It will be used to evaluate a regimental-sized cavalry unit performing a screen mission. Due to time constraints, a LATAM scenario cannot be developed to support this study; thus, the only LRS that will be used will be LRS AGMC.

(b) High-resolution scenarios (HRS). No certified SWA or LATAM scenarios currently exist for evaluating cavalry missions; therefore, two SWA scenarios will be developed: one for evaluating a guard mission (HRS AGMC 1.0) and one for evaluating a screen mission (HRS AGMC 2.0). Due to the time constraints of the study, the study team will not be able to develop a LATAM scenario; the number of HRS will be limited to the two SWA scenarios.

(c) A summarization of the HRS and the LRS to be used is provided in table 1 below.

Table 1. Runs design to the AGMC Analytical Support Plan

SCENARIO	MODEL	MISSION	BASE CASE	AIR CAV REGT	LIGHT CAV REGT	MOTORIZED INF BDE
LRS AGMC	CORBAN	SCREEN	X	X	X	X
HRS AGMC 1.0	JANUS	GUARD	X	X	X	X
HRS AGMC 2.0	JANUS	SCREEN	X	X	X	X

(2) All force cost data must be auditable from TAFCS master data base files.

(3) Force costs for the base case and each of the alternative units will be developed by costing at the same level of detail.

(4) This LIA will be constrained in scope and depth by time, with a completion date of 31 Mar 91.

(5) Due to the level of resolution of current data defining these units, manpower requirements will be determined only in terms of enlisted personnel.

3. **Environmental and threat considerations**.

a. Environment. The battle does not include climatic variations, nuclear, biological, or chemical warfare.

b. Threat. The threat year for each of the scenarios will be 2004.

4. **Methodology**.

a. Related studies. The following studies will be reviewed. Other related efforts may be identified and reviewed during this literature search.

(1) "Light Cavalry Regiment Analysis." October 1990. Fort Knox, KY.

(2) "Air/Ground Cavalry 1980-1985 Study." April 1979. DTIC number R683268730.

b. Success criteria for alternatives. Success is defined as a "yes" answer to the following questions.

(1) JANUS scenarios.

(a) In both the guard and screen scenarios, did the Blue forces in each alternative detect 85 percent of all Red reconnaissance forces in its area of interest?

(b) In both the guard and screen scenarios did the Blue forces in each alternative destroy 80 percent of the Red reconnaissance forces detected?

(c) In both the guard and screen scenarios, did the Blue forces in each alternative detect 65 percent of all forces in its area of interest?

(d) In the guard scenario, did the Blue forces prevent Red forces from reaching the pipeline until after 0900 on D+5.

(e) In the guard scenario, did the Blue forces remain combat effective ($\geq$ 65 percent) during the guard mission?

(2) CORBAN scenarios.

(a) During the screen mission, did the Blue forces in each alternative remain above 80 percent strength until 0600 on D+5 (the start of the guard mission)?

(b) At the conclusion of the screen mission, did the Blue forces in each alternative have sufficient remaining strength ($\geq$ 65 percent) to conduct a follow-on mission?

c. Essential elements of analysis (EEA).

(1) Deployment.

(a) How well can each of the force designs be deployed by air? (EEA 1)

(b) How many sorties are required to resupply each of the force designs with classes III [petroleum, oil, and lubricants (POL)] and V (ammunition)? (EEA 2)

(2) Cost.

(a) What are the force costs for the base case and for each of the three alternatives? (EEA 3)

(b) What are the costs for the logistics support required at echelons above brigade/regimental level to support the base case and each of the three alternatives? (EEA 4)

(3) Logistics impact.

(a) What are the logistics force structure requirements at echelons above division (EAD) for the base case and each of the alternatives? (EEA 5.1)

(b) What are the annual maintenance manhour (AMMH) requirements for the base case and each of the alternatives? (EEA 5.2)

(c) What is the mechanic manpower requirement at each maintenance level created by the AMMH requirements determined in 4c(3)(b), above, by military occupational specialty (MOS)? (EEA 5.3)

(d) What are the supply requirements for the base case and for each of the alternatives at the regiment/brigade level and for the theater? (EEA 5.4)

(e) What are the requirements for major items of equipment to support the supply requirements determined in 4c(3)(d), above? (EEA 5.5)

(4) Mobility. Are each of the force designs 100 percent mobile with organic resources? If not, what percentage is? (EEA 6)

(5) Missions.

(a) Surveillance.

1. How well is the unit able to detect and report all enemy forces in its area of interest? (EEA 7)

2. How well is the unit able to perform surveillance without being detected? (EEA 8)

(b) Screen.

1. How far forward does the unit provide early warning of the advancing enemy? (EEA 9)

2. How well is the unit able to repel and/or destroy enemy reconnaissance elements? (EEA 10)

3. How well is the unit able to bring nonlong-range indirect fires (e.g., exclude MRLS, ATACMS, BLK II, etc.)? (EEA 11)

4. How well is the unit able to survive while performing its mission? (EEA 12)

5. What is the operational requirements of classes III and V for each of the force designs? (EEA 13)

6. How well does the unit bring long-range artillery (e.g., MRLS, ATACMS, BLK II, etc.) and air fires to bear on known or suspected enemy locations? (EEA 14)

7. How well does the unit provide human intelligence (HUMINT) verification of intelligence developed by technological means? (EEA 15)

8. How well does the unit operate at extended ranges? (EEA 16)

(c) Guard.

1. How far forward does the unit provide early warning of the advancing enemy? (EEA 9)

2. How well is the unit able to repel and/or destroy enemy reconnaissance elements? (EEA 10)

3. How well is the unit able to bring to bear indirect fires? (EEA 11)

4. How well is the unit able to survive while performing its mission? (EEA 12)

5. How well does the unit prevent enemy ground observation and direct fire against the main body? (EEA 17)

6. How well does the unit cause the enemy's first echelon to deploy? (EEA 18)

d. Measures of effectiveness (MOE) correlated to specific EEA as indicated.

(1) Deployment.

(a) The number of air sorties required by aircraft type (C17, C5, and C141) for air deployment of the different forces. (Any equipment not transportable by air will be identified.) (EEA 1)

(b) The number of air sorties required for resupply of classes III and V. (EEA 2)

(2) Cost.

(a) Force cost for each alternative and base case. (EEA 3)

(b) The logistics support requirements (back to corps) for the base case and each alternative. (EEA 4)

(3) Logistics impact.

(a) Combat service support (CSS) force structure differences for the base case and each alternative. (EEA 5.1)

1. The number of additional logistics units required for each alternative and the base case.

2. The manpower requirements for each alternative and the base case.

3. The equipment requirements for each alternative and the base case.

(b) Annual Maintenance Manhour (AMMH) requirements by MOS for the base case and each alternative. (EEA 5.2)

(c) The mechanics manpower requirements at each maintenance level. (EEA 5.3)

(d) Supply requirements for each alternative regiment/brigade for the base case and for each alternative (EEA 5.4):

1. Class III (POL) expressed in gallons/day.

2. Class V (ammunition) expressed in short tons/day.

3. Class VII (major end items) expressed in short tons/day.

4. Class IX (repair parts) expressed in short tons/day.

(e) The major items of equipment required to support the supply requirements determined above. (EEA 5.5)

(4) Mobility. "Go/no go" response linked with time and resource requirements for movement. (EEA 6)

(5) Missions.

(a) Surveillance.

1. The number of unique detections by Blue cavalry elements of Red elements. (EEA 7)

2. The number of Red elements that remain undetected during the surveillance mission. (EEA 7)

3. The number of unique detections by Red of Blue cavalry elements. (EEA 8)

(b) Screen.

1. The time of event and number of unique detections by Blue cavalry elements. (EEA 9)

2. The number of Red reconnaissance elements killed by Blue cavalry elements. (EEA 10)

3. The number of Red reconnaissance elements that passed through the screen. (EEA 10)

4. The number of Red elements killed by indirect fire. (EEA 11)

5. The number of combat effective (60 percent) Blue cavalry troops/companies/elements remaining after mission completion. (EEA 12)

6. The number of gallons/short tons of classes III and V consumed on a daily basis. (EEA 13)

7. Number of Red elements killed by long-range artillery and air fires called in by screening force elements. (EEA 14)

8. Volume or percentage of intelligence developed by technological means, verified by HUMINT. (EEA 15)

9. Time and distance associated with HUMINT verification. (EEA 15)

10. The time and distance associated with the detection of Red forces. (EEA 16)

11. The ability of the Blue forces to logistically support operations at extended ranges. (EEA 16)

(c) Guard.

1. The time of event and number of unique detections by Blue cavalry elements. (EEA 9)

2. The number of Red reconnaissance elements killed by Blue cavalry elements. (EEA 10)

3. The number of Red reconnaissance elements that passed through the screen. (EEA 10)

4. The number of Red elements killed by indirect fire. (EEA 11)

5. The number of combat effective (60 percent) Blue cavalry troops/companies/elements remaining after mission completion. (EEA 12)

6. The number of unique detections by Red of Blue main-body elements. (EEA 17)

7. The number of Red direct fire engagements versus Blue main body. (EEA 17)

8. Main body Blue losses to Red direct fire missions. (EEA 17)

9. Time elapsed until deployment of enemy's first echelon. (EEA 18)

e. Alternatives.

(1) Armored cavalry regiment (ACR): 1996+ Army of Excellence (AOE) [Base case (appendix 1)].

(2) Air cavalry regiment: 2004 (appendix 2).

(3) Light cavalry regiment: 2004 (appendix 3).

(4) Separate motorized brigade: 2004 (appendix 4).

f. System Employment and Organization Plan. N/A

g. Mission profiles. N/A

h. Models. Candidate models and analytic tools include:

(1) JANUS. JANUS is a brigade-level, stochastic model. Two SWA HRS reflecting a guard and screen mission will be modeled to discern differences among various force designs.

(2) CORBAN. CORBAN is a corps-level, deterministic model. A low-resolution SWA scenario will be modeled to discern differences among the various force designs.

(3) Automated Air Load Planning Systems (AALPS). AALPS is a logistical model which will be used to determine aircraft sortie requirements for deployment and sustainment. This model will provide sortie requirements for the C5A, C17, and the C141 aircraft.

(4) The Army Force Cost System is a cost model which will be used by TRAC-White Sands Missile Range (TRAC-WSMR) in the development of future costs.

(5) Force Analysis Simulation of Theater Administration and Logistics Support (FASTALS) is a theater-level force "roundout" model that computes the logistics workloads generated within a theater and determines the combat support (CS) and CSS units that are doctrinally required to support it.

i. Method of analysis.

(1) The overall methodology is described in the following paragraphs. Appendix 6 provides specific methodology by EEA.

(2) The base case will be a 1996+ time frame, ACR, AOE organization. The alternatives will be 2004 force and equipment. The alternatives will be developed by the appropriate proponent school. Each alternative will be in sufficient detail to permit evaluation by combat simulation, by cost estimation, by deployment simulation, and by sustainment analysis.

5. **Decision criteria**. This analysis plan does not provide input to all parameters being measured in the AGMC evaluation. The scope of this plan is limited to those quantifiable parameters that the sponsor, CAC-CD, requested for analysis support. Therefore, the end product of this effort will be combined with subjective analysis of the remaining parameters being conducted by CAC-CD.

6. **Resources support requirements**.

a. Support requirements.

(1) **TRAC-Operations Analysis Center (TRAC-OAC), Studies Directorate (SD).**

(a) Write analytical support plan.

(b) Serve as lead agency for incorporating analysis provided by other agencies into final analysis.

(c) Prepare scripted briefing of final analysis.

(d) Write final report.

(e) Serve as lead agency for deployability and sustainability analysis.

(f) Serve as lead agency for mobility analysis.

(g) Serve as supervising agency for the analysis of JANUS runs.

(h) Serve as lead agency for the analysis of CORBAN runs.

(i) Serve as supervising agency for the force cost analysis.

(2) **TRAC-OAC, Production Analysis Directorate (PAD).**

(a) Develop the SWA AGMC base case for CORBAN.

(b) Serve as lead agency for CORBAN computer simulation runs for the base case and alternative force designs.

(c) Serve as supporting agency for the analysis of CORBAN runs.

(3) **TRAC-Scenarios and Wargaming Center (TRAC-SWC)**.

(a) Provide assistance in the development of base case scenarios for JANUS and CORBAN runs to include temporary duty (TDY) trip(s) to TRAC-WSMR.

(b) Chair certification briefing for the JANUS and CORBAN base case scenarios.

(4) **TRAC-Studies Analysis Center (TRAC-SAC)**.

(a) Provide one officer to serve as data manager for the study.

(b) Serve as lead agency for the development of data for the study.

(5) **TRAC-WSMR.**

(a) Serve as lead agency for JANUS computer simulation runs for the base case and each alternative.

(b) Serve as lead agency for the analysis of data obtained from the JANUS runs.

(c) Provide a scripted briefing of the JANUS analysis.

(d) Provide supporting appendices (JANUS background, gaming, and results) for the AGMC evaluation report.

(e) Serve as lead agency for the force cost analysis of the base case and each alternative.

(f) Provide a scripted briefing of the force cost analysis.

(g) Provide a feeder report of the force cost analysis.

(6) **TRAC-Fort Lee (TRAC-LEE)**. Provide a Logistic Impact Analysis (LIA) to both TRAC-WSMR and to the AGMC Study Director.

(7) **CAC Threats.**

(a) Provide certification of threat portrayal to TRAC-SWC for base case and each alternative.

(b) Attend pre-certification workshop at TRAC-WSMR.

(8) **CAC-CD.**

(a) Coordinate actions/requirements with the Armor, Aviation, and Infantry Schools (proponent schools) and incorporate their input.

(b) Provide force designs for the base case and each alternative (through proponent schools).

(c) Provide (through proponent schools) schemes of maneuver for the base case and each alternative in each scenario.

(d) Provide technical assistance via representatives from the proponent schools in the employment of the alternative designs in CORBAN and JANUS.

(9) **Command and General Staff College, Concepts and Doctrine Directorate (CGSC-CDD).** Review the doctrinal employment of Blue forces in support of the certification effort.

b. Resource requirements.

(1) Travel: $14,000.

(2) Contracts: none.

c. Data requirements. The best available data will be used in all cases for this study.

7. **<u>Study schedule</u>.**

a. General/overall milestones.

(1) CAC-CD provides base case ACR force design documentation [16 Jan 91].

(2) CAC-CD provides force design documentation for each alternative [16 Jan 91].

(3) Scripted briefing of total analysis [1 Jun 91].

(4) Final report [31 Jul 91].

b. JANUS gaming/analysis milestones.

(1) Data review [10 Jan 91].

(2) Review of base case scheme of maneuver [10 Jan 91].

(3) Base case gaming and certification [5 Feb 91].

(4) Review of alternative force design schemes of maneuver [13 Feb 91].

(5) Alternative force design gaming completed [1 Apr 91].

(6) In progress review (IPR) (emerging results) [9 Apr 91].

(7) Scripted briefing of JANUS analysis [30 Apr 91].

(8) Supporting appendices [31 May 91].

c. CORBAN gaming/analysis milestones.

(1) Review of base case scheme of maneuver [10 Jan 91].

(2) Review of data and alternative force designs schemes of maneuver [13 Feb 91].

(3) Base case gaming and certification [4 Mar 91].

(4) Alternative force design gaming and briefing of results [30 Apr 91].

d. Deployability analysis milestone. Analysis completed by 30 Mar 91.

e. Mobility and sustainability analysis milestone. Analysis completed by 30 Apr 91.

f. LIA milestone. Analysis and feeder report completed by 31 Mar 91.

g. Force costing analysis milestones.

(1) Analysis completed and scripted briefing prepared [30 Apr 91].

(2) Feeder report completed [30 Jun 91].

8. References.

a. CAC-CD message, ATZL-CG, 1901355S Jul 90, Subject: Air Ground Motorized Cavalry Evaluation.

b. CAC-CD memorandum, ATRC-FS, 21 Dec 90, Subject: Air Ground Motorized Cavalry Evaluation (request for analytical support).

9. Concurrences. The following agencies have participated in the preparation of this document and concur with it.

a. Force Design Directorate, Combined Arms Command-Combat Developments, Fort Leavenworth, Kansas.

b. Threats Directorate, Combined Arms Command, Fort Leavenworth, Kansas.

c. Concepts and Doctrine Directorate, Command and General Staff College, Fort Leavenworth, Kansas.

d. TRADOC Analysis Command-Fort Lee, Fort Lee, Virginia.

e. TRADOC Analysis Command-White Sands Missile Range, White Sands Missile Range, New Mexico.

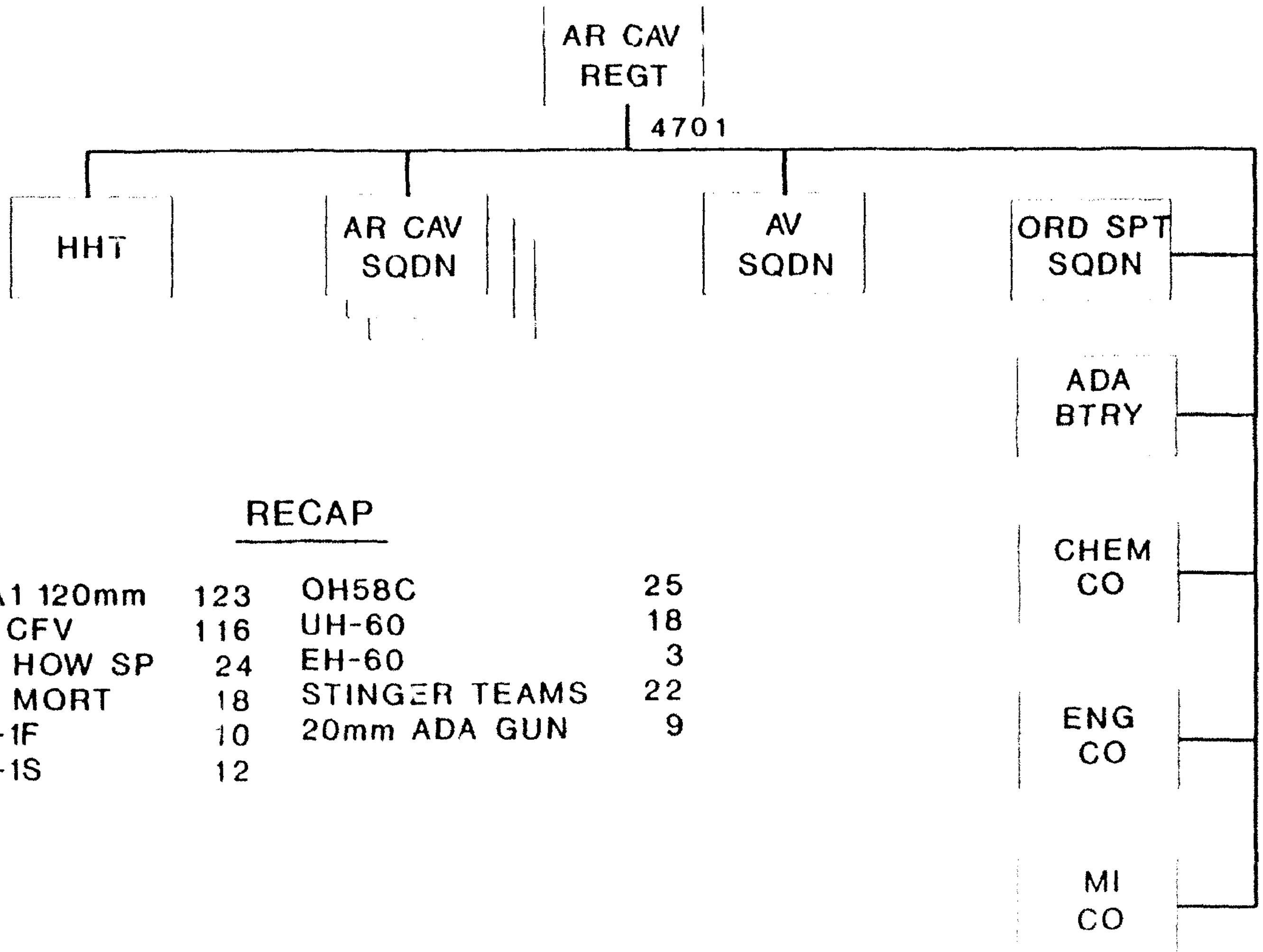
f. TRADOC Analysis Command-Studies and Analysis Center, Fort Leavenworth, Kansas.

g. TRADOC Analysis Command-Scenarios and Wargaming Center, Fort Leavenworth, Kansas.

APPENDIX 1

ARMORED CAVALRY REGIMENT BASE CASE

ARMORED CAVALRY REGIMENT BASE CASE OBJECTIVE AOE



29 JAN 91

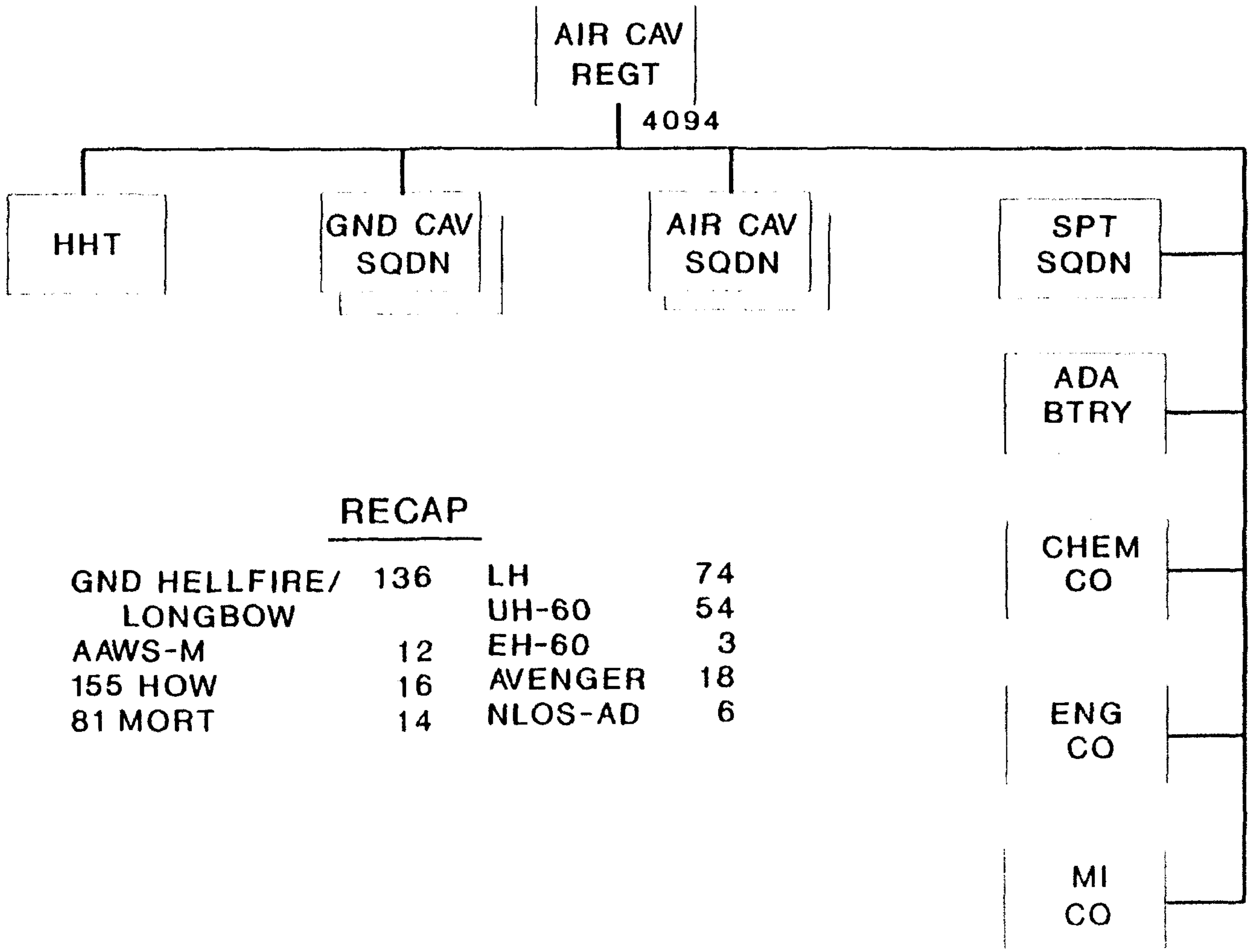
RECAP

M1A1 120mm	123	OH58C	25
M3 CFV	116	UH-60	18
155 HOW SP	24	EH-60	3
120 MORT	18	STINGER TEAMS	22
AH-1F	10	20mm ADA GUN	9
AH-1S	12		

APPENDIX 2

AIR CAVALRY REGIMENT

AIR CAVALRY REGIMENT



RECAP

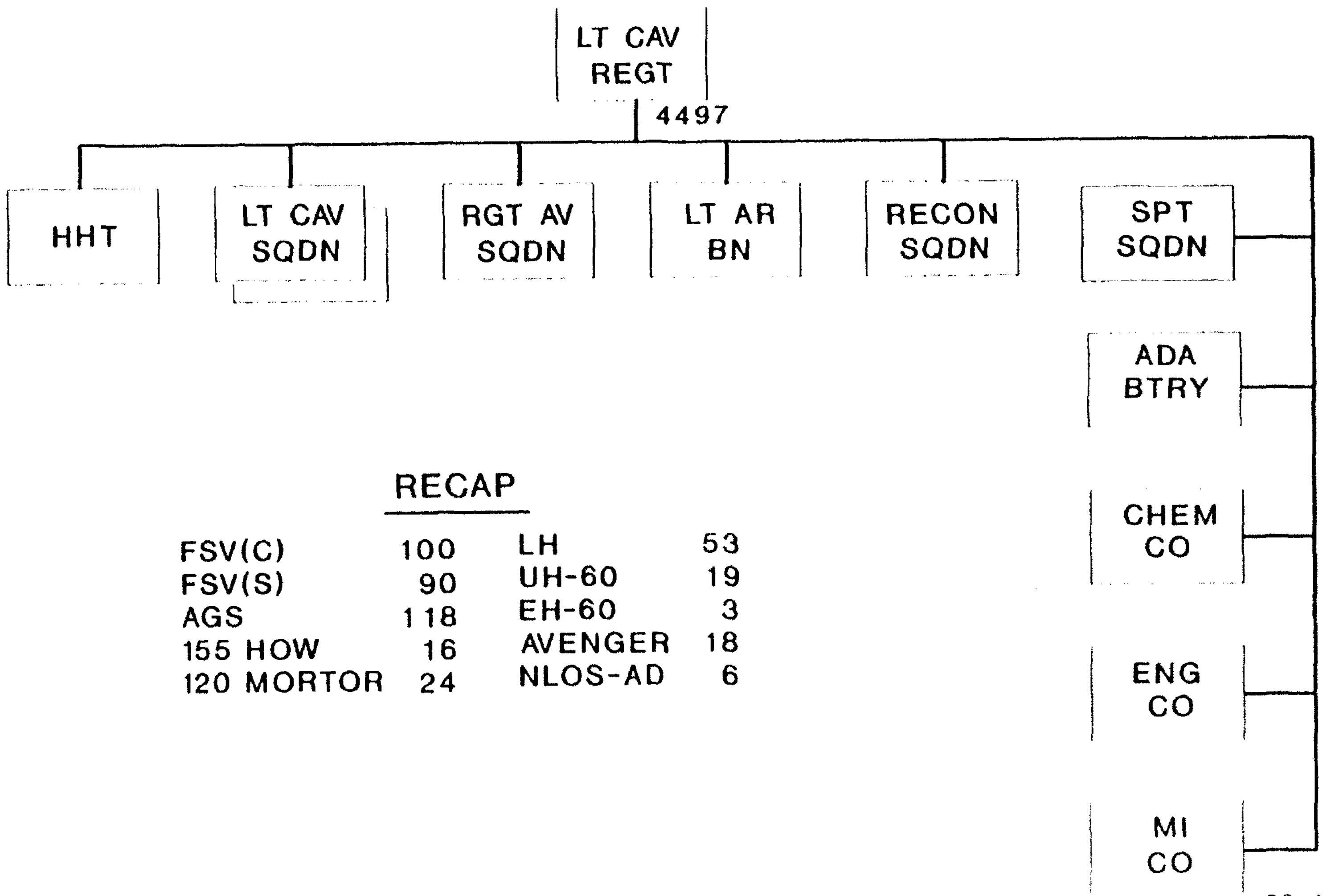
GND HELLFIRE/ LONGBOW	136	LH	74
		UH-60	54
AAWS-M	12	EH-60	3
155 HOW	16	AVENGER	18
81 MORT	14	NLOS-AD	6

29 JAN 91

APPENDIX 3

LIGHT CAVALRY REGIMENT

LIGHT CAVALRY REGIMENT



RECAP

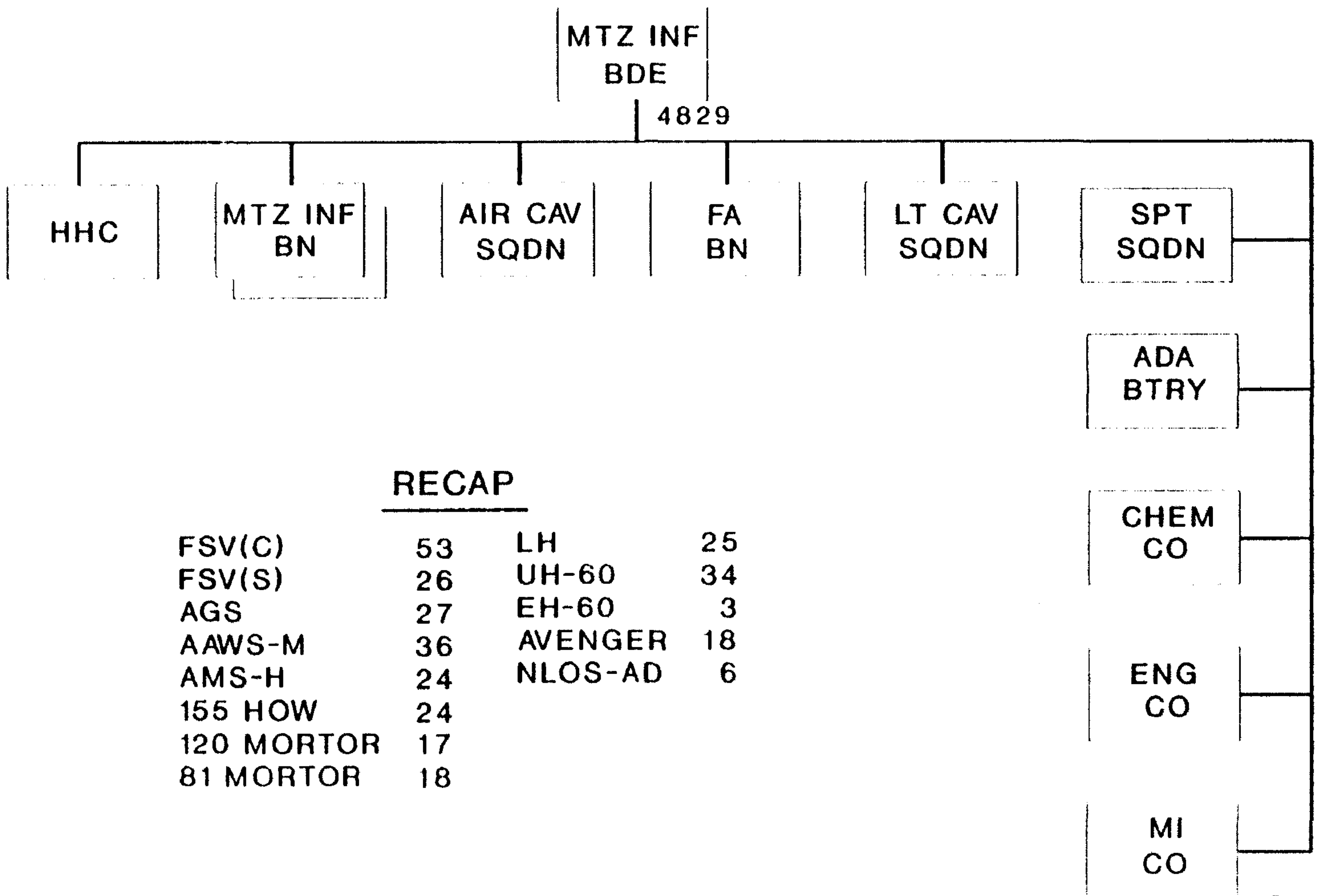
FSV(C)	100	LH	53
FSV(S)	90	UH-60	19
AGS	118	EH-60	3
155 HOW	16	AVENGER	18
120 MORTOR	24	NLOS-AD	6

29 JAN 91

APPENDIX 4

MOTORIZED INFANTRY REGIMENT

MOTORIZED INFANTRY BRIGADE



RECAP

FSV(C)	53	LH	25
FSV(S)	26	UH-60	34
AGS	27	EH-60	3
AAWS-M	36	AVENGER	18
AMS-H	24	NLOS-AD	6
155 HOW	24		
120 MORTOR	17		
81 MORTOR	18		

15 MAR 91

APPENDIX 5

REQUEST FOR SUPPORT

DEPARTMENT OF THE ARMY
U.S. ARMY COMBINED ARMS CENTER AND FORT LEAVENWORTH
FORT LEAVENWORTH, KANSAS 66027-5000

REPLY TO
ATTENTION OF

ATZL-CDF-A

18 December 1990

MEMORANDUM FOR Director, TRAC-Operations Analysis Center

SUBJECT: Analytical Support for the Air Ground Motorized Cavalry (AGMC) Evaluation

1. References.

a. CAC-CD message, ATZL-CG, 190135Z Jul 90, Subject: Air Ground Motorized Cavalry Evaluation.

b. Meeting among Mr. Keller, CAC-CD; Mr. Torok, CAC-CD; LTC Spencer, OAC; Dr. Godfrey, OAC; Mr. Schorr, OAC; and CPT Tabacchi, OAC; 21 Nov 90, SAB.

c. AGMC In Progress Review, 29 Nov 90.

2. Per reference 1a, Cdr, TRADOC ta ked Cdr, CAC-CD to evaluate several corps-level reconnaissance and security forces. The forces to be evaluated are:

a. Air Cavalry Regiment [developed by the Aviation School].

b. Light Cavalry Regiment [developed by the Armor School].

c. Motorized Infantry Brigade [developed by the Infantry School].

3. The AGMC evaluation is a part of the AirLand Battle-Future Contingency Forces Study (ALB-F CFS) and will be briefed at a 30 Apr/1 May 91 Action Officer Workshop.

4. To assist CAC-CD in the evaluation of the force designs, request Operations Analysis Center (OAC) provide the following analytical support which was discussed in references 1b and 1c.

a. Determine the number of sorties required to air deploy each of the force designs.

b. Determine the required short tons/gallons of classes III and V for each of the force designs (daily rate and 30-day total). Additionally, determine the number of sorties required to resupply each of the force designs with classes III and V.

ATZL-CDF 18 December 1990
SUBJECT: Analytical Support for the Air Ground Motorized Cavalry (AGMC) Evaluations

c. Determine the force costs for each design.

d. Determine if each of the force designs are 100% mobile with organic resources.

e. Evaluate the ability of each of the force designs to accomplish the following missions.

(1) Surveillance

(2) Screen

(3) Guard

(4) Covering force

f. During the mission evaluations, determine the following:

(1) The ability of the force designs to bring long range artillery and air fires to bear on known or suspected enemy locations.

(2) The ability of the force designs to provide HUMINT verification of intelligence developed by technological means.

(3) The ability of the force designs to operate at extended ranges.

g. For the evaluation of missions, the following is the prioritized list of scenarios.

(1) Southwest Asia (SWA)

(2) Latin America (LATAM)

(3) Europe (EUR)

5. POC for this action is Mr. Torok/4882

R. L. Keller
ROBERT L. KELLER
Director, FDD

CF:
Dir, SD, TRAC-OAC
Dir, ALB-F CFS Study, TRAC-OAC

APPENDIX 6

ANALYSIS METHODOLOGY

APPENDIX 6

ANALYSIS METHODOLOGY

1. **Purpose**. The purpose of this appendix is to describe the analytic methodology which will be used in evaluating the Air Ground Motorized Cavalry (AGMC) design alternatives.

2. **Deployment methodology**.

a. **Essential elements of analysis (EEA) 1. How well can each of the force designs be deployed by air?**

(1) Scope. The three design alternatives along with a base case design for an armored cavalry regiment (ACR), Army of Excellence (AOE), based organization in a 1996+ time frame will be used for evaluation. All forces will contain systems to the same level of detail in order to ensure a comparative data base for analysis.

(2) Methodology. The Automated Air Load Planning System (AALPS) will be used to determine aircraft sortie requirements for the deployment of each of the force designs. The aircraft under consideration will be C5A, C141, and C17. The C5A will be used to establish a relationship between the three alternatives with the base case ACR (note that the C5A is the only aircraft capable of deploying the heavy equipment in the ACR). The C141 and C17 will then be used for evaluating the three alternative designs.

(3) Measures of effectiveness (MOE). The number of aircraft sorties required by aircraft type (C17, C5, and/or C141) for air deployment of the forces (any equipment not transportable by air will be identified).

(4) Expected results. The analysis will identify the force that requires the least number of aircraft sorties necessary for deployment.

b. **EEA 2. How many sorties are required to resupply each of the force designs with classes III [petroleum, oil, and lubricants (POL)] and V (ammunition)?**

(1) Scope. The air sorties required to resupply each of the designs will be analyzed.

(2) Methodology. AALPS will be used to determine aircraft sorties necessary to provide the force designs with their respective class III and V requirements (see paragraph 2b for determination of class III and V requirements).

(3) MOE. The number of aircraft sorties required for resupply of classes III and V.

(4) Expected results. The analysis will identify the force that requires the least number of aircraft sorties necessary for the resupply of classes III and V.

3. <u>Cost methodology</u>.

a. **EEA 3. What are the force costs for the base case and for each of the three alternatives?**

(1) Scope. Address force cost for the base case and for each of the alternative forces, with focus on essential mission and mission support equipment, and personnel by category, officer, warrant officer, and enlisted.

(2) Methodology.

(a) The cost categories to be identified will be operations and maintenance Army, military personnel Army, and procurement. Non-recurring and recurring costs over a 20-year period will be rolled up as totals of the subordinate costs.

(b) Costs will be displayed in constant fiscal year (FY) 92 dollars.

(c) Costs prior to FY91 are to be considered as sunk costs.

(d) Costs in FY91 are costs to complete.

(3) MOE. The force costing for the base case and each alternative.

(4) Expected results. Rank ordering by cost.

b. **EEA 4. What are the costs for the logistics support required at echelons above brigade/regimental level to support the base case and each of the three alternatives?**

(1) Scope. Address logistics costs for the base case and for each of the alternative forces, with focus on essential mission and mission support equipment, and personnel by category, officer, warrant officer, and enlisted.

(2) Methodology. See EEA 3.

(3) MOE. The logistics costs for the base case and each alternative.

(4) Expected results. Rank ordering.

4. <u>LIA methodology.</u>

a. EEAs.

(1) **EEA 5.1. What are the logistics force structure requirements at echelons above division (EAD) for the base case and each of the alternatives?**

(2) **EEA 5.2. What are the annual maintenance manhour (AMMH) requirements for the base case and each of the alternatives?**

(3) **EEA 5.3. What is the mechanic manpower requirement at each maintenance level created by the AMMH requirements determined in 4f(2), above, by MOS?**

(4) **EEA 5.4. What are the supply requirements for the base case and for each of the alternatives at the regimental/ brigade level and for the theater?**

(5) **EEA 5.5. What are the requirements for major items of equipment to support the supply requirements determined in 4f(4), above?**

b. Scope.

(1) The LIA will determine the logistics force structure requirements for a Southwest Asia (SWA) theater, by SRC, for a base case and each of the three alternatives. The base case and alternatives are described in paragraph 4g.

(2) The study will examine requirements for supply classes III (POL), V (ammunition), VII (major end items), and IX (repair parts) for the base case and each of the three alternatives.

(3) The study will examine maintenance requirement differences under current support concepts.

(4) The scenario to be used will be the SWA attack scenario developed by the Concepts Analysis Agency (CAA) to support the Operation DESERT SHIELD Supportability Analysis conducted by the Combined Arms Support Command (CASCOM) and the Logistics Evaluation Agency (LEA).

c. Methodology. (EEAs 5.1 through 5.5).

(1) General overview. An overview of the LIA is depicted in figure 1. A comparative analysis will be performed to determine requirements for the base case and the alternatives in each of the following areas.

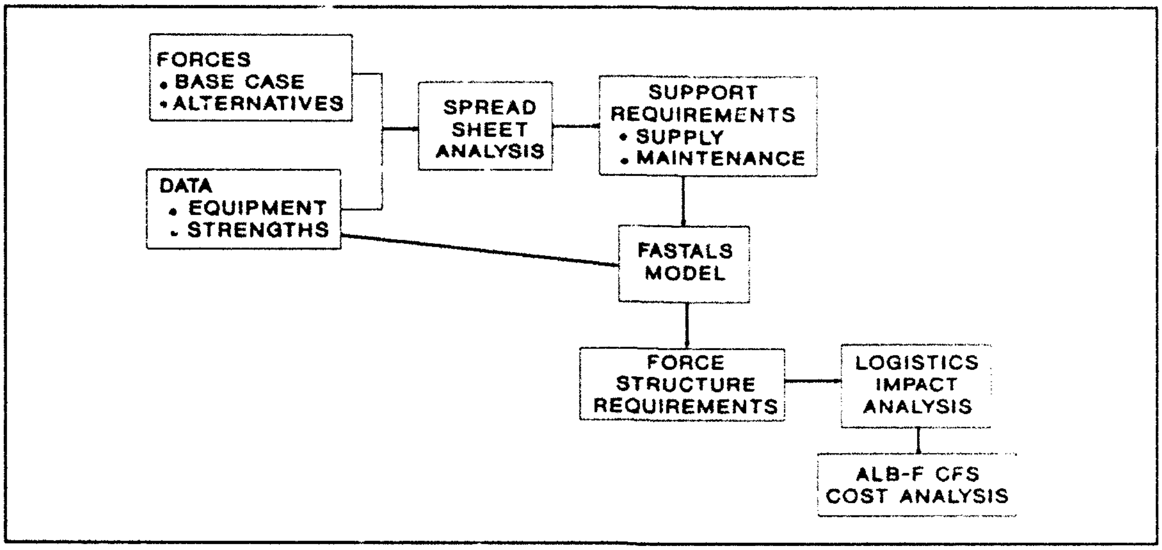


Figure 1. LIA overview

(a) Supply, maintenance, and transportation.

(b) Combat service support (CSS) force structure.

(2) Supply, maintenance, and transportation analysis.

(a) Supply. The determination of supply requirements is a two-phase process.

1. The first phase is a spreadsheet analysis of supply planning factor data from the CASCOM logistics data base (LDB), which will determine the average daily operational requirements for selected (III, V, VII, IX) classes of supply for each alternative regiment. A spreadsheet calculation and aggregation process will be used on the supply requirements for the primary equipment within each alternative regiment.

2. The second phase will use the FASTALS model to calculate the average daily tonnage required for each class of supply for an entire theater. Consumption data for all classes of supply determined in the first phase are used as input to FASTALS.

(b) Maintenance. The maintenance requirements for the base case and each alternative will be determined using a spreadsheet analysis and will be based on the AMMH requirements for the equipment in each alternative regiment/brigade. The AMMH requirements will be converted into mechanic manpower

requirements using header codes. Maintenance manhour requirements will also be used an input to FASTALS based on "leader" mechanic types to determine total maintenance unit requirements.

(c) Transportation. The daily requirement for classes III and V will be converted into truck transportation requirements for each alternative regiment/brigade. FASTALS will determine the impact on petroleum and medium truck company requirements at EAD for each alternative.

(3) CSS force structure analysis. This analysis determines logistics force structure requirements at EAD using the FASTALS model.

d. Measures of effectiveness (MOEs).

(1) CSS force structure differences for the base case and each alternative.

(a) The number of additional logistics units required for each alternative and the base case.

(b) The manpower requirements for each alternative and the base case.

(c) The equipment requirements for each alternative and the base case.

(2) AMMH by MOS for the base case and each alternative.

(3) The mechanics manpower requirements at each maintenance level.

(4) Supply requirements for each alternative regiment/brigade for the base case and for each alternative.

(a) Class III expressed in gallons/day.

(b) Class V expressed in short tons/day.

(c) Class VII expressed in short tons/day.

(d) Class IX expressed in short tons/day.

(5) The major items of equipment required to support the supply requirements determined above.

e. Expected results. Rank ordering.

5. <u>Mobility methodology</u>. EEA 6. Are each of the force designs 100 percent mobile with organic resources? If not, what percentage is?

a. Scope. All forces and equipment contained in each alternative will be reviewed to predict organic mobility.

b. Methodology. Each alternative will be analyzed for sufficiency of vehicles, platforms, and personnel to be 100 percent mobile. In addition, mobility will be linked to the low-resolution scenario (LRS) battle for the ability of each alternative to perform its mission.

c. MOE. "Go/no go" response linked with time and resource requirements for movement.

d. Expected results. Each alternative will be given a mark of pass/fail for 100 percent mobility with organic resources. Additionally, insights from the analysis of LRS gaming will be included.

6. **Mission methodology**.

a. **EEA 7. How well is the unit able to detect and report all enemy forces in its area of interest?**

(1) Scope. The three design alternatives will be evaluated, along with a base case ACR, AOE based organization in a 1996+ time frame. For each of the designs, the ability to conduct surveillance will be evaluated.

(2) Methodology. The JANUS model (a brigade-level, stochastic model) will be used to evaluate each designs' ability to conduct surveillance. Two high-resolution scenarios (HRS) will be run. Both of these scenarios will be on SWA terrain.

(3) MOE.

(a) The number of unique detections by Blue cavalry elements of Red elements.

(b) The number of Red elements that remain undetected during the surveillance mission.

(4) Expected results. Each alternative can be rank-ordered and nonparametric statistics (Kruskal-Wallis) may be applied to discern statistically significant differences.

b. **EEA 8. How well is the unit able to perform surveillance without being detected?**

(1) Scope. See scope for EEA 7.

(2) Methodology. See methodology for EEA 7.

(3) MOE. The number of unique detections by Red elements of Blue cavalry elements.

(4) Expected results. See expected results for EEA 7.

c. **EEA 9. How far forward does the unit provide early warning of the advancing enemy?**

(1) Scope. For each design alternative, the ability to screen and guard will be evaluated. Each of these missions consist of Army Training and Evaluation Program (ARTEP) tasks which will be individually evaluated as EEAs. The above EEA is an example of the type ARTEP tasks which will be evaluated.

(2) Methodology. The JANUS model and the Corps Battle Analyzer (CORBAN) (a corps-level, deterministic model) will be used to evaluate the appropriate EEA. Two HRS will be run on JANUS and one LRS will be run on CORBAN. Appropriate quantitative and "flow of battle" data will be extracted for the EEA.

(3) MOE. The time of event and number of unique detections by Blue cavalry elements.

(4) Expected results. The alternatives can be ranked according to "quickness" of warning, as well as, to total number of detections. Nonparametrics may be applied to discern statistical differences.

d. **EEA 10. How well is the unit able to repel and/or destroy enemy reconnaissance elements?**

(1) Scope. See scope of EEA 9.

(2) Methodology. See methodology of EEA 9.

(3) MOE.

(a) The number of Red reconnaissance elements that passed through to the screen.

(b) The number of Red reconnaissance elements killed by Blue cavalry elements.

(4) Expected results. The alternatives can be rank-ordered according to this measure of lethality, as well as, according to this measure of failure. Nonparametrics may be applied to discern statistical differences.

e. **EEA 11. How well is the unit able to bring to bear the indirect fires?**

(1) Scope. See scope for EEA 9.

(2) Methodology. See methodology for EEA 9.

(3) MOE. The number of Red elements killed by indirect fire.

(4) Expected results. Rank ordering.

f. EEA 12. How well is the unit able to survive while performing its mission?

(1) Scope. An important measure of the "goodness" of a force design is that of survivability. This measure reflects a unit's capability to complete its mission while remaining a viable entity.

(2) Methodology. Computer simulations will provide quantitative measures of remaining force structures, both as whole value and as a percent of initial force strength.

(3) MOE. The number of combat effective (60 percent) Blue cavalry troops/companies/elements remaining after mission completion.

(4) Expected results. Rank-ordering.

g. EEA 13. What is the operational requirements of classes III and V for each of the force designs? (EEA 13)

(1) Scope. The operational requirements of classes III and V to include forward arming and refueling points (FARPs) for each of the regiment/brigade force designs will be analyzed that is needed to support the overall unit mission.

(2) Methodology. The operational requirements for classes III and V will be determined from actual consumption as a result of unit movement and ammunition expenditures as depicted in the LRS.

(3) MOE. The number of gallons/short tons of classes III and V consumed on a daily basis.

(4) Expected results. The quantity of classes III and V that each of the force designs will need to support the overall unit mission.

h. EEA 14. How well does the unit bring long-range artillery and air fire to bear on known or suspected enemy locations?

(1) Scope. Each of the unit designs must be capable of directing long-range artillery and air fires to known or suspected enemy locations. The analysis will attempt to discriminate among the alternatives with regard to their inherent abilities.

(2) Methodology. The CORBAN model will be used to assess the units' ability to call for long-range artillery and air fires. Quantitative measures will be extracted with regard to the effectiveness of the called fires.

(3) MOE. The number of Red elements killed by long-range artillery and air fires called in by screening force elements.

(4) Expected results. Rank-ordering; nonparametric applications.

i. **EEA 15. How well does the unit provide human intelligence (HUMINT) verification of intelligence developed by technological means?**

(1) Scope. Each unit must be capable of providing HUMINT verification of all types of intelligence gathering systems. The analysis will include actual human line-of-sight verification of technologically gathered intelligence.

(2) Methodology. Combat simulation models will be employed to correlate sensor detections with human detections. The analysis will include the number of verifications and their timeliness.

(3) MOE.

(a) Volume or percentage of intelligence developed by technological means verified by HUMINT.

(b) Time and distance associated with HUMINT verification.

(4) Expected results. Rank-ordering.

j. **EEA 16. How well does the unit operate at extended ranges?**

(1) Scope. Each unit must be capable of operating at extended ranges to be able to provide accurate intelligence as early as possible.

(2) Methodology. CORBAN will be used to assess the units' capability to locate and identify enemy forces as early as possible. Logistical implications of extended operations will also be evaluated.

(3) MOE.

(a) The time and distance associated with the detection of Red forces.

(b) The ability of the Blue forces to logistically support operations at extended ranges.

(4) Expected results. Rank-ordering.

k. **EEA 17. How well does the unit prevent enemy ground observation and direct fire against the main body?**

(1) Scope. This EEA refers to each of the alternative's ability to guard. As an ARTEP task under this mission, it will be evaluated as such.

(2) Methodology. See methodology EEA 9.

(3) MOE.

(a) The number of unique detections by Red elements of Blue main-body elements.

(b) The number of Red direct fire engagements versus Blue main body elements.

(c) Main body Blue losses to Red direct fire missions.

(4) Expected results. Rank ordering; nonparametric applications.

l. **EEA 18. How well does the unit cause the enemy's first echelon to deploy?**

(1) Scope. See scope for EEA 17.

(2) Methodology. JANUS will be used to evaluate this EEA. Appropriate quantitative and "flow of battle" data will be extracted for the EEA.

(3) MOE. Time elapsed until deployment of enemy's first echelon.

(4) Expected results. Rank-ordering; nonparametric applications.

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APPENDIX B

ESSENTIAL ELEMENTS OF ANALYSIS

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APPENDIX B

ESSENTIAL ELEMENTS OF ANALYSIS

B-1. Deployment.

a. *How well can each of the force designs be deployed by air? (EEA 1)* All force designs are deployable by air. The AIRCR uses the least number of C5 or C17 sorties for deployment while the MIB uses the least number of C141 sorties for deployment. The ACR and the MACR are both deployable by air, but the number of sorties required makes it impractical for air deployment.

b. *How many sorties are required to resupply each of the force designs with classes III (petroleum, oil, and lubricants (POL)) and V (ammunition)? (EEA 2)* Supplies consisted of dry cargo (to include packaged petroleum items) and ammunition. Bulk fuel and water will normally be supplied by host nation support or purchased through contracting agents. Overall sustainment of the forces had no real impact on the deployment of any of the force designs. The AIRCR required the least number of aircraft sorties for the deployment of resupply.

B-2. Cost.

a. *What are the force costs for the base case and for each of the three alternatives? (EEA 3)* Detailed spreadsheets for the base case, the four alternatives, and the LIA can be found in appendix G, annex A. Table B-1 presents total costs for the ACR, MACR, LCR, AIRCR, and MIB. These are building blocks for the 20-year decision costs.

Table B-1. AGMC force costs (FY92)

Force	Nonrecurring	Recurring OPTEMPO	Total
ACR	$ 986,068,380	$ 961,460,094	$1,947,528,474
MACR	1,886,140,688	556,039,897	2,442,180,585
LCR	1,564,343,792	488,279,134	2,052,622,926
AIRCR	1,608,828,518	555,897,832	2,164,716,350
MIB	942,007,309	438,743,681	1,380,750,990

b. *What are the costs for the logistics support required at echelons above brigade/ regimental level to support the base case and each of the three alternatives? (EEA 4)* Detailed spreadsheets for the base case, the four alternatives, and the LIA can be found in appendix G, annex A. Table B-2 presents costs of the CSS units as specified by TRAC-LEE.

Table B-2. LIA additional costs (FY92)

Force	Nonrecurring	Recurring OPTEMPO	Total
ACR	$ 73,237,000	$ 43,660,000	$116,897,000
MACR	73,237,000	43,660,000	116,897,000
LCR	53,246,000	31,380,000	84,626,000
AIRCR	73,237,000	43,660,000	116,897,000
MIB	53,246,000	31,380,000	84,626,000

B-3. Logistics impact.

a. *What are the logistics force structure requirements at corps for the base case and each of the alternatives? (EEA 5.1)* The LCR and the MIB have identical support requirements (table B-3) and are less than the AIRCRs and the ACRs. The AIRCR and ACRs have higher support force structure requirements because their higher fuel consumption increases the requirement for petroleum truck companies and associated maintenance.

Table B-3. Support force structure

	Unit	STR	ACR	MACR	LCR	AIRCR	MIB
08419LO	Vet Det	6	1	1	1	1	1
08498LO	Med Det	13	1	1	1	1	1
14413DB	Finance team	19	1	1	1	1	1
27512LD	JAG team	5	1	1	1	1	1
43209LO	Maint Co	200	2	2	1	2	1
43509LG	Wheel rep team	7	4	4	4	4	4
55540LE	TRL Trans Pt	8	2	2	2	2	2
55728L1	Med Trk Co (Cargo)	191	1	1	1	1	1
55728L1	Med Trk Co (Water)	191	1	1	1	1	1
55728L2	Med Trk Co (Petro)	177	2	2	1	2	1
55827LO	TML Svc	361	1	1	1	1	1
42419LO	Repair parts Co	185	0	0	0	0	0
	Total spaces		1,584		1,207	1,584	1,207

b. What are the annual maintenance manhour (AMMH) requirements for the base case and each of the alternatives? (EEA 5.2)

(1) The ACRs have the highest overall requirement for maintenance (figure B-1). They also pass the most maintenance into the corps in the form of GS maintenance. The ACR maintenance requirements are strictly a function of their preponderance of heavy armored equipment compared to the other alternatives. The MACR has a lower GS requirement, but the increased flying hours of the LH-LB over its predecessor systems increases the internal unit requirement for maintenance.

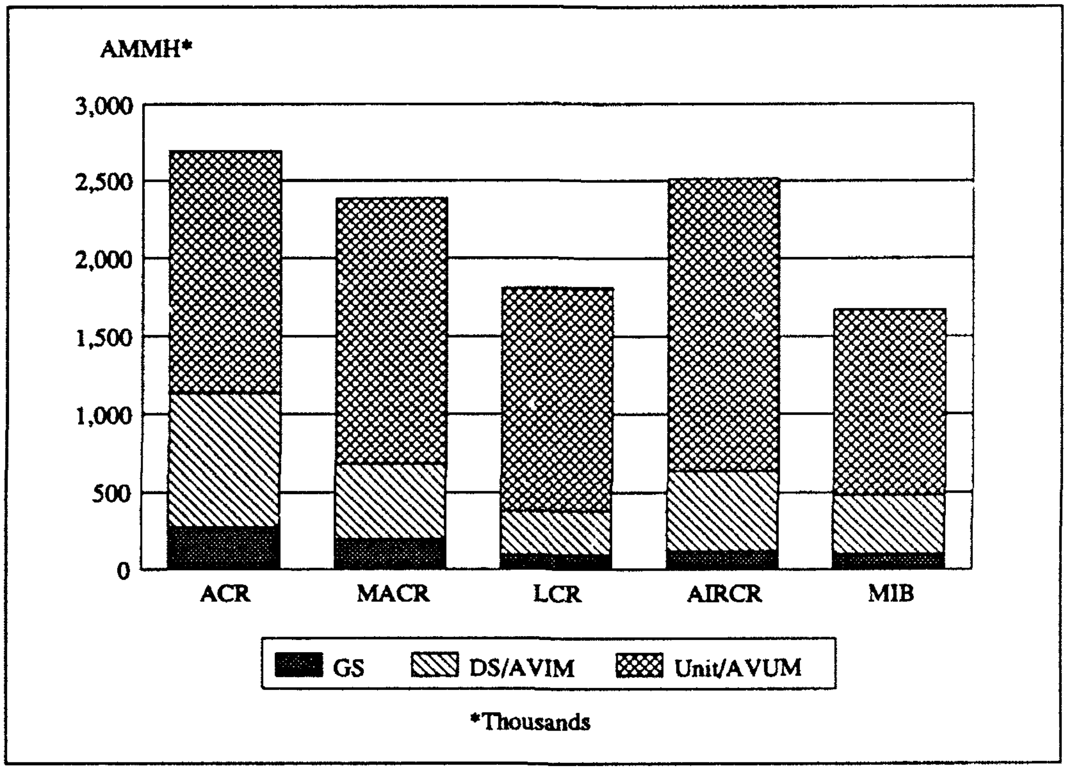


Figure B-1. Annual maintenance manhours

(2) Among the non-ACR alternatives, the MIB generates the lowest requirement for maintenance. The AIRCR has the highest requirement due to its higher density of aircraft.

c. What is the mechanic manpower requirment at each maintenance level created by the AMMH requirements determined above by military occupational specialty (MOS)? (EEA 5.3) The number of mechanics that the GS AMMH shown in figure B-1 equate to is shown in figure B-2. The ACRs are significantly higher than the other regiments. Modernization of the ACR with the introduction of the ASM tank and self propelled howitzer reduces the DS and GS requirement for mechanical maintenance, fire control and turret mechanics but, increases the unit requirements.

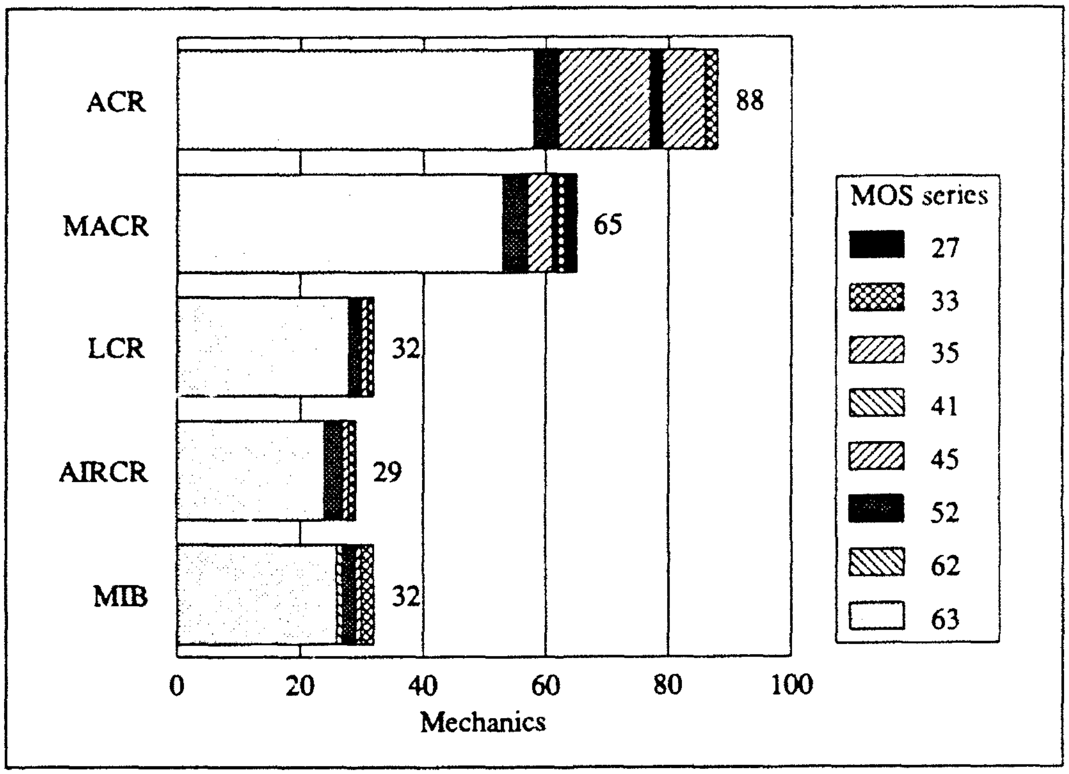
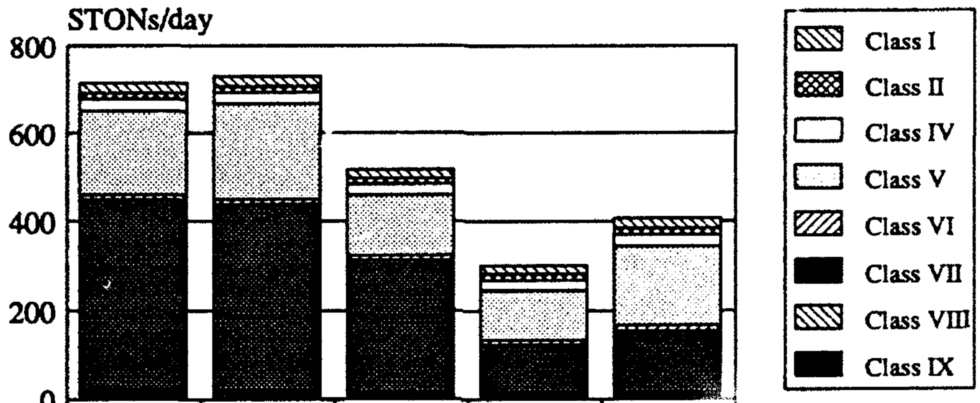


Figure B-2. GS mechanic requirements

d. What are the supply requirements for the base case and for each of the alternatives at the regiment/brigade level and for theater? (EEA 5.4)

(1) For dry commodities expressed in STONs, the ranking of requirements from lowest to highest is shown in figure B-3. The requirements consist predominantly of ammunition and major end items and the results are generally intuitive. Class VII requirements (major end items) are primarily influenced by equipment weight with the AIRCR (the lightest unit) having the lowest requirement and the ACRs (the heaviest units) having the highest requirement. The class V (ammunition) requirement is driven by the number of howitzer tubes. The MIB and the ACRs have 24 tubes each and all others have 16.

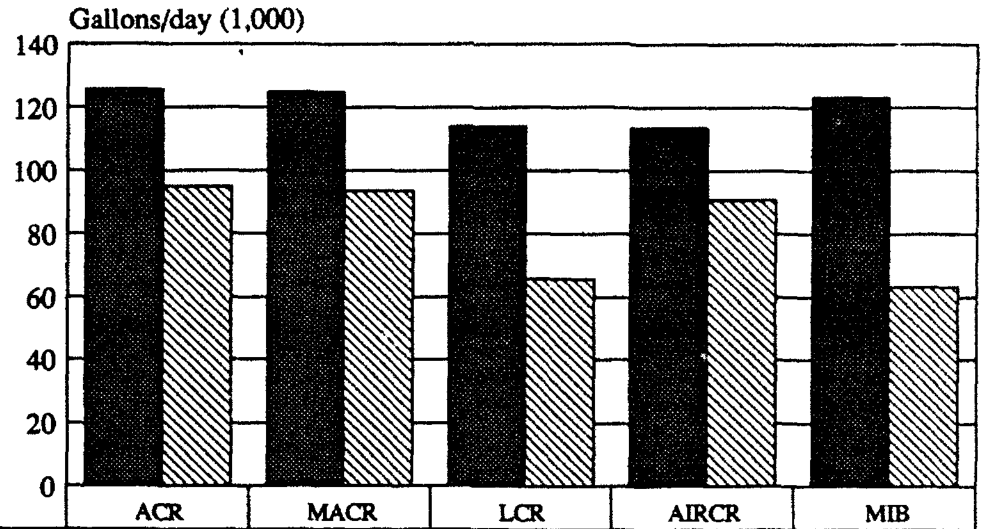


	ACR	MACR	LCR	AIRCR	MIB
Class I	22.2	22	20.1	20	21.7
Class II	14.7	14.6	13.4	13.2	14.5
Class IV	26.7	26.5	24.2	24.1	26.2
Class V	190.4+	216.7+	134.7*	111.4*	177.7+
Class VI	10.7	10.6	9.7	9.7	10.5
Class VII	423.5	414.9	297.2	108.1	139.4
Class VIII	3.8	3.8	3.5	3.5	3.8
Class IX	13.7	12.7	6.4	4.8	5.5

+ 24 tubes
* 16 tubes

Figure B-3. Sustainment requirements

(2) Bulk fuel requirements (figure B-4) are influenced by two primary factors: the number of aircraft and overall equipment weight. The AIRCR (aircraft) and the ACRs (weight) are almost equivalent in class III consumption for these two reasons.



	ACR	MACR	LCR	AIRCR	MIB
Water	125.7	124.8	114.1	113.6	123.2
Class III	94.9	93.5	65.9	90.7	63.2

Water Class III

Figure B-4. Sustainment requirement

(3) Water consumption for this analysis was based on 20 gallons per person per day and is therefore strictly population driven. Water consumption could increase up to 80 gallons per person per day without an increased support force structure impact.

e. What are the requirements for major items of equipment to support the supply requirements determined above? (EEA 5.5) The base case and the alternatives included all major items of equipment to support the supply requirements as designed. It was not necessary to add any additional pieces of equipment.

B-4. Mobility. Are each of the force designs 100 percent mobile with organic resources? If not, what percentage is? (EEA 6) All force designs are 100 percent mobile with all organic resources. All alternatives have similar wheeled vehicles and therefore have similar tactical mobility. The use of the family of medium tactical vehicles (FMTV) would improve force mobility by allowing more personnel to be located in the cab of the vehicle, thus, allowing for more supplies to be carried as cargo in the vehicles.

B-5. Missions.

a. *Surveillance.*

(1) How well is the unit able to detect and report all enemy forces in its area of interest? (EEA 7)

(a) SWA.

1. All three alternatives successfully detected more than 65 percent of the total Red force in both the screen and guard missions.

2. In the screen mission, the percentages of Red detected are as follows: MIB, 71 percent; AIRCR, 73 percent; and LCR, 81 percent. The differences among alternatives is more closely correlated with end game criteria and tactics than with the "detection power" of the alternative. The end game criteria established with regard to the screen mission required that the Red recon be stripped and that preplanned Blue ground maneuver be completed. The MIB used four LH-LBs forward to support the ground systems. As the Red recon came forward, the Blue systems detected, killed, and shadowed the Red movement. The striping of the Red recon and the pre-planned Blue ground maneuver were occurring simultaneously. These tactics allowed the two end game criteria to be satisfied simultaneously, and therefore, fewer detections occurred during the game time.

3. The AIRCR had similiar success in the percentage of detections, using very different tactics. The AIRCR alternative had 18 LH-LBs forward, and the screen mission was adequately handled by these systems alone. The range and lethality of the LH-LB allowed these systems to eliminate all Red as they came within range and with little vulnerability. The success of the LH-LB freed the Blue ground systems to move to their preplanned positions relatively early in the battle. This combination allowed the end game criteria to be satisfied fairly quickly and with fewer detections than the LCR.

4. The LCR had the largest percentage of detections in the screen mission with 81 percent. This can be attributed to the tactics employed. The LCR employed six LH-LBs forward in support of their ground systems. A more balanced, "combined arms" approach was used where the ground systems began the screen taking on the light-skinned vehicles. Once the longer ranged Red systems came within range, the Blue ground systems turned the battle over to the longer range LH-LBs. These tactics were successful, but required the Blue ground systems to stay in the forward positions longer than the other alternatives. This delayed the satisfaction of the second end game criterion which was completion of preplanned Blue ground maneuver. This added time allowed for more Red systems to be detected while the ground systems were maneuvering.

5. The guard mission shows differences in the number of Red elements detected between alternatives. The percentages are as follows: MIB, 90 percent; AIRCR, 76 percent; and LCR, 93 percent. Once again, the tactics and end game criteria are influencing factors. The end game criteria for the guard mission was to attrite the Red force to 25 percent or allow Red to reach the pipeline. All three alternatives kept the Red force from reaching the pipeline and were able to destroy 75 percent of the Red force.

6. The key in the guard mission was the tactics employed. The LCR and the MIB used more traditional cavalry tactics. The Blue ground systems were forward. They stripped the thin-skinned vehicles and then turned the battle over to the LH-LBs as the ground systems maneuvered back to stronghold positions. This battle turnover took time and allowed more Red forces to be detected. In addition, these alternatives employed scouts forward to provide targeting information. These vehicles provided detection information.

7. The AIRCR was able to complete the guard mission by solely relying on the LH-LB. The aircraft were forward. The Blue ground systems were behind the LH-LB in the event that it became necessary for the air to turn the battle over. This never occurred. The 25 LH-LB employed by the AIRCR were sufficient to handle the threat and contributed 99.6 percent of the kills. The lack of necessity to turn the battle over limited the number of detections made by the Blue ground systems and, therefore, less total detections were made than the other alternatives. No forward ground scouts were used in this alternative.

8. The result of the high resolution gaming certainly points out that tactics and end game criteria are just as important in determining the number of detections as is the inherent capability of the unit to detect. The bottom line is that all three alternatives detected more than the required amount of Red systems, and variances in the specific percentages cannot be directly correlated to "ability to detect."

(b) EUR. Each alternative was successful at detecting and reporting enemy forces in tne area of interest. The LCR and MIB designs, which were similiar in equipment each detected 99 percent of the main body. This is a function of the range of the AGS and FSV, both equipped with 4km systems. This range capability allowed the Red force to get closer to the Blue forces and provided opportunity for the Blue designs to "see" almost the entire Red force. The AIRCR design relied on the standoff of the LH/LB and the HV/LB. This additional range, over the systems in the LCR and MIB, allowed the AIRCR to be successful at attriting 75 percent of the Red force without being exposed to the entire Red main body and therefore, the AIRCR detected fewer vehicles at 90 percent.

(2) How well is the unit able to perform surveillance without being detected? (EEA 8)

(a) SWA.

1. During the screen mission, the average number of unique detections by Red of Blue cavalry were as follows: MIB, 54.8; AIRCR, 21.8; and LCR, 69.8. The tactics employed by each alternative can be directly correlated to the number of Blue elements detected. The AIRCR placed 18 LH-LBs forward and stripped the Red recon without having to commit the Blue ground forces. The ground forces remained outside the detection range of the Red systems because of the standoff provided by the LH-LB.

2. In the more traditional cavalry role of the MIB and the LCR, we see use of both Blue ground systems and Blue air assets. This "combined arms" approach provided more opportunity for the Red forces to detect the Blue elements. These opportunities did not turn into Blue killed as the survivability rates for the screen mission are similiar across all three alternatives.

3. In the guard mission, the average number of unique detections by Red of Blue cavalry elements were as follows: MIB, 58; AIRCR, 28.6; and LCR, 78.3. The numbers are in the same relative order and magnitude as for the screen. The logic of tactics influence is true in the guard as it was in the screen. Placing the air forward, as in the AIRCR alternative, allows the ground systems to be protected to a degree. Using a combined arms fight with all systems forward causes an increase in the Red capability to detect our systems. The results would be consistent, as long as the Blue air assets are sufficient to cover the mission single-handed. If the threat was overwhelming, and it became necessary for the Blue ground systems to provide support for the air, then the number of Blue systems detected could be expected to rise.

4. The intent of this MOE was to measure the vulnerability of the alternatives by determining how easily they could be seen and seemingly, therefore, killed. This logic was not consistent as we see great disparity in the number of Blue elements detected and less disparity in the correlated Blue killed. In fact, the majority of Blue killed was attributed to Red artillery prep fire and not to direct fire.

(b) EUR. As in SWA, this EEA had hoped to measure the "vulnerability" of each alternative to some degree. In fact, the quantities of systems of the screen, the positioning of forces on the screen, and the tactics employed had a much stronger effect on this measurement than the vulnerability of the design. The average number of Blue systems detected by Red forces were 71.8 for the LCR, 65 for the AIRCR, and 46 for the MIB. The quantities of ground systems forward for each alternative also have the same relative

comparison as the Blue systems detected (i.e., the LCR had the most ground systems forward, followed by the AIRCR, and the MIB had the least ground systems forward).

b. *Screen/guard.*

(1) How far forward does the unit provide early warning of the advancing enemy? (EEA 9)

SWA AND EUR. The positioning of the Red and Blue forces on the Janus terrain box and the long-range capability of the LH-LB is (present in all alternatives) allowed for immediate detection of the Red force. As each game began, detections were immediate across all three alternatives and, therefore, no time advantage could be associated with one alternative over the other.

(2) How well is the unit able to repel and/or destroy enemy reconnaissance elements? (EEA 10)

SWA AND EUR. All alternatives detected and killed all Red recon vehicles in all scenarios modeled.

(3) How well is the unit able to bring nonlong-range indirect fires? (EEA 11)

SWA AND EUR. The size of the Janus screen (50km by 50km in SWA and 45km by 45km in EUR), the Janus play of artillery vs moving vehicles, the range of direct fire Blue systems, and the tactics employed by each proponent school made this EEA impossible to differentiate among the alternatives. The number of Red systems killed by Blue artillery across all alternatives was consistently less than two percent of all Red kills. Other systems proved more valuable in contributing to Red killed and were therefore, played to a much greater degree.

(4) How well is the unit able to survive while performing its mission? (EEA 12)

(a) SWA. The remaining Blue forces in the guard mission are as follows: MIB, 79 percent; AIRCR, 90 percent; and LCR, 89 percent. The differences here are a function of tactics and the equipment employed. The major Blue losses occurred when the Red forces prepped the towns with artillery. The MIB suffered the most losses as they maneuvered their highly vulnerable HMMWVs to their preplanned positions in the towns. The other alternatives took their losses in the same locations, but the composition of the other alternatives did not present as many vulnerable vehicles.

(b) EUR. All alternatives were equally successful at remaining viable. At end game the MIB had 80 percent remaining, LCR had 81 percent; and AIRCR had 79 percent. The MIB and LCR remained viable based on systems employing advanced technology and tactics which provided overwatch for ground system withdrawal. The AGS provided overwatch for

the withdrawal of FSV, and the LH-LB provided overwatch for the withdrawal of the AGS. The AIRCR survived because of standoff.

(5) What are the operational requirements of classes III and V for each of the force designs? (EEA 13)

(a) Basic load data was input for all major weapon systems gamed in terms of ammunition and POL for the CORBAN runs. This also included GS transport vehicles. All elements were started with maximum POL holdings and appropriate ammo constraints. Consumption rates for POL were provided from surrogate VIC data.

(b) Of the three alternatives gamed, the AIRCR consumed the most POL due to the large number of LH-LB screen and deep missions. The MIB, with its extensive use of light vehicles and limited number of LH-LBs, proved to be the least resource intensive.

(c) Limited ground engagement, due to effective screening movements, provided little ammo consumption across the spectrum of alternatives, and what was consumed was very scenario driven. Organic artillery ammo consumption is higher in the ACR and the MIB due to the higher number of artillery systems (24 vs 16).

(6) How well does the unit bring long-range fires (e.g., MLRS, (TGW and ATACMS Blk II) and air fires to bear on known or suspected enemy locations? (EEA 14)

(a) The LCR and AIRCR provided the most effective use of deep fires to destroy the enemy. The deep scout elements of the LCR and MIB and the deep LH-LB missions of the AIRCR allow for much greater C2 resulting in more effective fires. The differences in the alternatives are equipment driven. The MIB alternative provided less forward FSVs which resulted in a smaller search pattern and fewer fires.

(b) The BAI and other air fires were planned by corps and gamed without information from the alternatives thus, no analysis was conducted.

(7) How well does the unit provide HUMINT verification of intelligence developed by technological means? (EEA 15) The LCR with the largest forward deployed scouts provides a larger detection area and better detection capabilities at earlier times and better sustainment. AIRCR is not as sustained as the LCR because of downtime needed for rearm and refuel operations. This downtime causes surges in their surveillance capabilities. The MIB provides for less forward deployed scouts resulting in a smaller search pattern and a corresponding reduction in surveillance capabilities and fewer detections.

(8) How well does the unit operate at extended ranges? (EEA 16) Results of the excursion that analyzed the extended logistical capability for each of the alternatives are shown in table B-4.

Table B-4. Extended capabilities

Ground: Trucks assumed to be available for diesel fuel. Air: JP4 fuel (in thousands of gallons).					
	ACR	MACR	LCR	AIRCR	MIB
CONS/FARP/24 hours	35	21	23	23	13.5
CAP/FARP	30	15	10	15	7.5
CONS/CAP	1.2	1.4	2.3	1.5	1.8
FARPs are within 1.5 driving hours to a FSB.					
Note: AV has 3 FARPs while AR and IN have 2 FARPs.					

The terms "CONS/FARP/24 HRS" refers to the fuel consumption per FARP for a 24-hour period; "CAP/FARP" refers to the fuel capacity derived from the number of HEMTTs per FARP; and "CONS/CAP" refers to the fuel consumption with respect to the fuel capacity which represents the number of round trips, from FARP to the nearest FSB, the vehicles would need to perform to support the aviation operations for a 24-hour period. This shows that all alternatives had enough capability to support their aviation operations.

(9) How well does the unit prevent enemy ground observation and direct fire against the main body? (EEA 17)

<u>SWA AND EUR</u>. The only Blue main body elements which were on the Janus screen were the Blue artillery. These artillery elements were never seen by direct fire Red elements in any of the three alternatives.

(10) How well does the unit cause the enemy's first echelon to deploy? (EEA 18)

<u>SWA AND EUR</u>. Based on the tactics certified by CAC threats, the enemy did not deploy its first echelon in any of the alternatives gamed. It was determined that Red would go to ground with 75 percent attrited and that became the end game criteria.

APPENDIX C

SUCCESS CRITERIA

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APPENDIX C

SUCCESS CRITERIA

C-1. Janus, SWA scenario.

a. *In both the guard and screen scenarios, did the Blue forces in each alternative detect 85 percent of all Red reconnaissance forces in its area of interest?* All three alternatives detected 100 percent of the Red reconnaissance forces. The Red recon element consisted of 91 vehicles. All alternatives achieved success at this criterion.

b. *In both the guard and screen scenarios, did the Blue forces in each alternative destroy 80 percent of the Red reconnaissance forces detected?* All three alternatives destroyed 100 percent of the Red recon force.

c. *In both the guard and screen scenarios, did the Blue forces in each alternative detect 65 percent of all forces in its area of interest?*

(1) All three alternatives successfully detected more than 65 percent of the total Red force in both the screen and guard missions.

(2) In the screen mission, the percentages of Red detected are as follows: MIB, 71 percent; AIRCR, 73 percent; and LCR, 81 percent. The differences among alternatives are more closely correlated with end game criteria and tactics than with the "detection power" of the alternative. The end game criteria established with regard to the screen mission required that the Red recon be stripped and that preplanned Blue ground maneuver be completed. The MIB used four LH-LBs forward to support the ground systems. As the Red recon came forward, the Blue systems detected, killed, and shadowed the Red movement. The striping of the Red recon and the preplanned Blue ground maneuver were occurring simultaneously. These tactics allowed the two end game criteria to be satisfied simultaneously, and therefore, fewer detections occurred during the game time.

(3) The AIRCR had similiar success in the percentage of detections, but the tactics employed were very different. The AIRCR alternative had 18 LH-LBs forward, and the screen mission was adequately handled by these systems alone. The range and lethality of the LH-LB allowed these systems to eliminate all Red as they came within range and with little vulnerability. The success of the LH-LB freed the Blue ground systems to move to their preplanned positions relatively early in the battle. This combination allowed the end game criteria to be satisfied fairly quickly and with fewer detections than the LCR.

(4) The LCR had the largest percentage of detections in the screen mission with 81 percent. This can be attributed to the tactics employed. The LCR employed six LH-LBs forward in support of their ground systems. A more balanced, "combined arms" approach

was used where the ground systems began the screen taking on the light-skinned vehicles. Once the longer ranged Red systems came within range, the Blue ground systems turned the battle over to the longer range LH-LBs. These tactics were successful but required the Blue ground systems to stay in the forward positions longer than the other alternatives. This delayed the satisfaction of the second end game criterion which was completion of preplanned Blue ground maneuver. This added time allowed for more Red systems to be detected while the ground systems were maneuvering.

(5) The guard mission shows differences in the number of Red elements detected between alternatives. The percentages are as follows: MIB, 90 percent; AIRCR, 76 percent; and LCR, 93 percent. Once again the tactics and end game criteria are influencing factors. The end game criteria for the guard mission was to attrite the Red force to 25 percent or allow Red to reach the pipeline. All three alternatives kept the Red force from reaching the pipeline and were able to destroy 75 percent of the Red force.

(6) The key in the guard mission was the tactics employed. The LCR and the MIB used more traditional cavalry tactics. The Blue ground systems were forward. They stripped the thin-skinned vehicles and then turned the battle over to the LH-LBs as the ground systems maneuvered back to stronghold positions. This battle turnover took time and allowed more Red forces to be detected. In addition, these alternatives employed scouts forward to provide targeting information. These vehicles provided detection information.

(7) The AIRCR was able to complete the guard mission by solely relying on the LH-LB. The aircraft were forward. The Blue ground systems were behind the LH-LB in the event that it became necessary for the air to turn the battle over. This never occurred. The 25 LH-LB employed by the AIRCR were sufficient to handle the threat and contributed 99.6 percent of the kills. The lack of necessity to turn the battle over limited the number of detections made by the Blue ground systems and, therefore, less total detections were made than the other alternatives. No forward ground scouts were used in this alternative.

(8) This success criterion was originally designed to measure each alternative's ability to detect (i.e., the more detections, the greater the alternative's ability to detect). The result of the high-resolution gaming certainly points out that tactics and end game criteria are just as important in determining the number of detections as is the inherent capability of the unit to detect. The bottom line is that all three alternatives detected more than the required amount of Red systems, and variances in the specific percentages cannot be directly correlated to "ability to detect."

d. *In the guard scenario, did the Blue forces prevent Red forces from reaching the objective until after 0900 on D+5?* The high-resolution gaming portrayed approximately 50 minutes of combat time. During this time frame, all three alternatives were able to guard the forces using the pipeline and were able to prevent the Red forces from reaching the pipeline. Based on the results of this small portion which was gamed, it is not possible to predict whether or not each alternative could have successfully prevented the Red forces from reaching the pipeline for three hours on D+5.

e. *In the guard scenario, did the Blue forces remain combat effective (greater than or equal to 65 percent) during the guard mission?* This success criterion requires each alternative to remain combat effective (greater than or equal to 65 percent) during the guard mission. All three alternatives successfully met this criterion. The remaining Blue forces are as follows: MIB, 79 percent; AIRCR, 90 percent; and LCR, 89 percent. The differences here are a function of tactics and the equipment employed. The major Blue losses occurred when the Red forces prepped the towns with artillery. The MIB suffered the most losses as they maneuvered their highly vulnerable HMMWVs to their preplanned positions in the towns. The other alternatives took their losses in the same locations, but the composition of the other alternatives did not present as many vulnerable vehicles.

C-2. Janus, Europe scenario.

a. *In both the guard and screen scenarios, did the Blue forces in each alternative detect 85 percent of all Red reconnaissance forces in its area of interest?* Each alternative was successful at detecting 100 percent of all Red reconnaissance forces in its area of interest. This Red recon force consisted of 64 vehicles. All alternatives achieve success at this criterion.

b. *In both the guard and screen scenarios, did the Blue forces in each alternative destroy 80 percent of the Red reconnaissance forces detected?* For the European guard mission, all alternatives were successful at stripping 100 percent of the Red recon force.

c. *In both the guard and screen scenarios, did the Blue forces in each alternative detect 65 percent of all forces in its area of interest?* This success criterion required each alternative to detect at least 65 percent of all forces in its area of interest. Each alternative was successful at this criterion, but results varied by tactics/equipment employed. The LCR and MIB designs, which were similiar in equipment, each detected 99 percent of the main body. This is a function of the range of the AGS and FSV, both equipped with 4K systems. This range capability allowed the Red force to get closer to the Blue forces and provided opportunity for the Blue designs to "see" almost the entire Red force. The AIRCR relied on the standoff of the LH-LB and the HV/LB. This additional range, over the systems in the LCR and MIB design, allowed the AIRCR to be successful at attriting 75 percent of the Red force without being exposed to the entire Red main body.

d. *In the guard scenario, did the Blue forces prevent Red forces from reaching the objective until after 0900 on D+5?* All alternatives were successful at preventing the Red force from reaching its objective during the 80 minutes of battle time. It is reasonable to assume, based on percentage remaining, that these designs could have destroyed the entire Red force on the Janus screen and remained a viable force.

e. *In the guard scenario, did the Blue forces remain combat effective (greater than or equal to 65 percent) during the guard mission?* All alternatives were equally successful at remaining viable. At end game the MIB had 80 percent remaining, LCR had 81 percent, and AIRCR had 79 percent. The MIB and LCR designs remained viable based on systems

employing low observable technology and tactics which provided overwatch for ground system withdrawal. The AGS provided overwatch for the withdrawal of FSV, and the LH-LB provided overwatch for the withdrawal of the AGS. The AIRCR survived because of standoff.

APPENDIX D

SCENARIOS

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APPENDIX D

SCENARIOS

There were three scenarios used during the AGMC evaluation. All of the documents are classified SECRET and have been published separately. They are entitled:

- SWA 3.0 (Southwest Asia), TRAC-SC 0390, and MURS-2041, volumes 1-4.

- Europe 9.0 (Alternative Corps Design Study), TRAC-SC 0190, and ACN 2042, volumes 1-4.

- High Res 32 (Armor Cav Squadron Guard), TRAC-SC 0295.

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APPENDIX E

MODELS

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APPENDIX E

ANNEX I

CORBAN

E-I-1. Introduction. This annex provides a summary description of the CORBAN model.

E-I-2. Summary description.

a. *Model overview.*

(1) CORBAN is a computer simulation of operational level combat processes. The model provides the capability to analyze the rear, central, and deep battles in a consistent and unified manner. It simulates various aspects of units in conflict. For example, the capability exists to simulate an operational maneuver unit disrupting both the command and logistics structure and defeating a large force through superior tactics. Although CORBAN's primary focus is on the ground battle, it also simulates air effects on ground combat through close air support and interdiction. Helicopter units can execute troop transport or fire support missions. CORBAN can simulate fire support in various missions. Artillery can be used for DS of maneuver units, GS of maneuver units, or interdiction and counterfire missions. Air defense units indirectly support maneuver units by engaging enemy aircraft.

(2) The model's most distinctive feature is its fully automated C2. This gives the model the capability to operate either in a stand-alone mode (where the model simulates successive actions of opposing players) or in the man-in-the-loop mode (where human players periodically revise the orders of the opposing forces, e.g., fragmentation orders).

(3) The simulation runs in a series of short timesteps. Units are processed in sequence based on their position in the command hierarchy. Interactions during a time cycle are reported through messages which travel both up and down the command chain. To simulate more realistic decisionmaking, higher level units can be cycled on a larger timestep than lower level units.

(4) Since less fidelity is required for units in the rear areas, the model provides the capability of using various lengths of timesteps, levels of terrain resolutions, and sizes of military units.

(5) CORBAN consists of three distinctive software components: preprocessor, combat simulation, and postprocessor. These components are written in FORTRAN augmented by the Modular Information Data Access System (MIDAS) language. MIDAS allows the use of complex data structures which employ pointers and data packing. FORTRAN was chosen as the simulation language to provide the capability of incorporating

sections of code from previous models. Its data structures use dynamic data storage to make the simulation efficient.

b. *Design goals.*

(1) CORBAN was designed to be a quick-running combat simulation on a microcomputer. Its original purpose was to allow rapid screening of operational concepts, tactics, and doctrine.

(2) Operational tactics and doctrine are input as part of CORBAN's data base. Consequently, CORBAN has considerably better resolution of the simultaneous deep, close, and rear battles than previous low-resolution models. One example of the model's resolution is that each unit has its own general axis of movement and it dynamically selects a route to its objective.

(3) CORBAN deviates from previous practice in low-resolution models by explicitly modeling weapons and sensors. The extent of explicit portrayal is based on the user's willingness to prepare detailed orders and operation descriptors. This allows the model to be responsive to the physical capabilities of the force employment. It also allows the simulation of a degradation in the mission effectiveness of a unit resulting from specific patterns of attrition. There is a pattern of attrition associated with each type of engagement, including the asymmetric engagements typical of a deep battle.

c. *Design approach.*

(1) The architecture of CORBAN emphasized two major design concepts: flexible code and statespace data storage. The concept of flexible code used generic subroutines to perform operations specified by input data. For example, ground maneuver units engaged in a direct battle use the same combat routine used by aircraft engaged by an air defense unit. The differences in the types of combat are specified by the data passed to the routine. Using input data to define specific characteristics of units and operation, rather than embedding them in the code, also enhances the flexibility of the code.

(2) One consequence of this approach is that the initial preparation of a data base is time consuming. However, this approach ensures that the elements of the model which influence the model results are specified by the user. In so doing, the same model can be used for various applications, with the differences in outcomes being focused on differences in the data bases.

(3) A second major architectural concept used by CORBAN is the use of statespace data storage. This concept employs the storage of all the data in a single large array called ISPACE. The data base is built through a series of postprocessor runs which initialize this array. Corrections to early portions of the data base can be made by re-entering the same elements, thus overwriting the error. Another advantage of the ISPACE concept is that the array can be retained after a simulation run. The ISPACE can then be used to restart the

model at any preselected point. Excursions can be made by revising ISPACE before the model is restarted.

d. *Key model concepts.*

(1) Entity situation. An entity represents a military unit element capable of independent actions. This is a key concept used in CORBAN. Each entity has an associated data structure which contains information on current position, assets, strength, suppression, superiors and subordinates, current mission and objective, perceived enemy orientation, and force ratio. The entity's situation is represented in an array of 32 boolean flags. These flags are used in the decision process to evaluate the entity's level of supply and enemy situation. The lowest echelon normally represented is a battalion, except where a specific capability, (such as a sensor platform or a missile battery) is required.

(2) Unit asset deployment patterns. Below the entity level, there is a second layer of detail which describes the entity's assets. An asset is a vehicle, weapon, or group of personnel assigned to a unit. The data structures associated with an asset contain different information depending on the type of asset. For example, weapon assets have expected kill parameters and transportation assets have parameters on cargo capacity. A deployment pattern refers to the position of assets relative to the unit's center. Detailed weapon range calculations are based on the deployment pattern described in the unit's operation descriptor.

(3) Operation descriptors and operation templates.

(a) Operation descriptors use generic types of operations to represent combat doctrine and does not contain information on a specific unit or location. It describes the capabilities and limitations of the operation and provides the contingencies for changes to another operation, unless changes are directed by a superior unit. It also contains data describing the operation execution such as speed, movement criteria, and force effectiveness.

(b) If units are disaggregated, the operation descriptor for upper echelon units contains data required to generate an operation template for subordinate units. Operation templates describe roles to be assigned as tasks for subordinates and role positions which are based on a relative scale, allowing the operation template to conform to the terrain in any simulated situation. Operation templates are the basis for automated C2. They give an entity the ability to generate appropriate actions for its subordinates.

(4) Orders, contingency definition. The plan of operations contains a series of orders which apply to specific units and objectives. These orders contain data on the unit's objective and the operation descriptor to be used for the mission. Contingencies are used to change from one order to an attached order. A contingency definition defines a set of conditions that must be either true or false in order for a contingency to be satisfied. These contingencies are compared with a unit's situation flags during the decision process.

(5) Terrain. CORBAN uses a series of nested hexagonal cells to represent terrain. The lowest hex level measures 3.5 km from one hex center to an adjoining hex center. The 3.5 km hexes are nested within 9.5 km hexes and the 9.5 km hexes within the 25 km hexes. Each terrain cell categorizes the level of forests, mountains, and urbanization, as well as the size of roads and rivers. Terrain affects the detection of assets, as well as movement speeds and path selection.

e. *Key model functions*. The model simulates the following nine major actions: see, shoot, provide, move, communicate, recover, decide, act, and plan. These functions are briefly described below.

(1) See.

(a) The see logic simulates the ability of a military unit to obtain information about itself and friendly and enemy units. At the beginning of each processing cycle, the unit evaluates its situation. It reevaluates its position relative to its objective and its strength, which may have changed relative to its base strength due to attrition.

(b) Perception of friendly and enemy units is a key part of the see logic. The unit perception is controlled by a search pattern associated with the unit's type or operation descriptor. A search pattern is described in terms of the hexes surrounding the unit and defines the aggregate "footprint" of the unit's sensor capabilities. Each hex in the description is rated on tactical importance by the search sequence and a given threat weight. A target list is created as enemy units are perceived. the target list is prioritized by the sequence of hexes searched, not by target importance.

(c) The sensor units do not have the capability to use a target list, but they can pass the perception information on to other units by using enemy unit roles. Enemy unit roles are defined by a set of characteristics that the perceived enemy unit must have to fill the role, thus controlling the information that can be passed. The characteristics include enemy position, operation, and unit type.

(2) Shoot. The shoot logic inflicts damage and suppression on opposing units placed on the shooting unit's target list by the see logic. A unit's fire capability is analyzed for each firing weapon type in its asset list, and the target damage is assessed against each asset type in the target unit. Weapon ranges between the firing weapon and the target(s) are measured in quarter kilometers (approximately); they use the deployment pattern of both the shooting and target units to determine the number of firing weapons and targets within firing range. Weapon effectiveness is also influenced by these deployment patterns.

(3) Provide. The provide logic simulates the push or pull of equipment, fuel, and ammunition to maneuver and artillery units. These supplies are distributed according to a priority list set up in the plan of the superior unit. The fuel and ammunition assets are transported to maneuver or artillery units using truck convoys.

(4) Move. The move logic simulates the movement of units to their objectives. The movement speed is based on data found in terrain speed tables and in the operation descriptor. The speed of a unit can be affected by terrain, its operation, force ratio, and fuel level. Route selection is made based on weighting factors and limitations defined in the operation descriptor.

(5) Communicate. The communicate logic simulates the transfer of information from one unit to another. The messages contain information concerning support requests, asset transfers, phase changes, perception reports, and regular reports. The time required to send and receive a message has two components: transmit time and receive time. Messages may be further delayed by suppression and/or jamming of either the transmitting or receiving unit.

(6) Recover. The recover logic simulates a unit's ability to recover from suppression and asset losses. After a period of time during which the unit is out of contact and not moving, the unit reevaluates and adjusts its base strength to its current strength. It thus perceives itself as a smaller unit than before, but at full strength.

(7) Decide. The decide logic simulates a military unit's ability to act on a new order from its superiors or to take action based upon its own situation. A unit takes action based upon its situation by changing operations or by responding to an action code. An action code signals the need for a one-time action. These actions include requesting priority fire support, generating a new objective for the current order, or causing a unit to be removed if it falls below a specified strength level.

(8) Act. The act logic implements the actions determined to be appropriate in the decide logic. These actions include: changing operations, sending fire support requests, transferring assets, changing hex level representation, generating new objectives, and reassigning facing directions.

(9) Plan. The plan logic applies exclusively to headquarters units. Headquarters uses an operation template to assign subordinates to friendly unit roles. The subordinates are assigned to roles based on their type, classification, mission, force ratio, and strength. The user must define which of these characteristics are required and the degree of variation allowed. The plan logic is invoked in response to phase changes, new orders, and actions taken within the act logic.

f. *Model assumptions and limitations.*

(1) Sequential processing of units. A recognized weakness of the model involves its architecture. Specifically, the units are processed sequentially, using an organizational tree structure. Within a timestep, each unit from one side performs the actions of look, shoot, decide, and move before the other side performs these actions. This does not allow proper resolution for unit-on-unit duels. In our current efforts, CORBAN is used as a screening tool investigating Blue corps against Red armies. Results are considered at several echelons above the resolution unit. In this context, CORBAN can still offer a legitimate screening capability.

While not appropriate for offering precise quantitative comparisons of systems and subordinate organizational capabilities, the model can be effectively used to quickly identify low-resolution alternatives worthy of closer scrutiny by other means.

(2) Indirect fire calculus. The insensitivity of the artillery methodology to target density is a major concern. Units with more target elements draw more fire with no regard to their level of cohesion/dispersion. The greater the difference in system density between belligerent, the greater the effect of this problem. In the current CORBAN efforts, the relative numbers of artillery and target systems on either side are not as disparate as in the typical defensive scenario. While precise, quantitative conclusions about artillery effects cannot be obtained, CORBAN results legitimately support investigation of trends and trade-offs in more general terms. This is particularly true when the number of systems remains constant between cases. Different munitions generally represent changes in lethality rather than changes in system density.

(3) Air defense and air activities. Air defense/air portrayal is recognized as a weakness in CORBAN. This is particularly true in the context of fixed wing/air defense. Any discussion of air/air defense capabilities should center as much on the capability to suppress or destroy the air defense systems as on the direct evaluation of air defense system capabilities against aircraft. Any insights must be substantiated by other means. Air defense/rotary wing portrayal is more acceptable.

(4) Limited logistic resolutions. Logistics play is not detailed enough to adequately gain significant combat service support insights. The effects of this shortcoming are greater for larger time periods. While logistics limitations must be considered, they are not as crucial in a six-day context as in a longer timeframe.

(5) Lack of environmental considerations. The model is only capable of playing one of the following visibility restricting conditions for the durations of the simulations runs: day, night, or smoke.

APPENDIX E

ANNEX II

Janus

E-II-1. Summary description and model overview. Janus is developed, maintained, and distributed by the U.S. Army TRADOC Systems Analysis Activity (TRASANA) located at White Sands Missile Range, New Mexico. TRASANA used the Lawrence Livermore National Laboratory prototype model Janus, delivered in January 1983, as the starting point for the Army model.

a. *Acquisition and development.* TRASANA acquired the prototype as a result of the Janus Acquisition and Development Project as directed by TRADOC in December of 1980. The principal effort of that project was to first acquire the hardware and then to acquire and standardize the code, algorithms, and data bases. The follow-on for the initial effort was to provide technical support within TRADOC and other Army organizations for continued development, use, and export of the model.

b. *Current status.* At this time, Janus uses Army-developed algorithms and data to model combat processes, the TRASANA data base utility "FORMS" for data base programming productivity and interactive data maintenance, and the TRASANA graphics package "GRAFAK" to manage the interaction between gamers and the simulation. The suite of programs comprising Janus consists of approximately 85,000 lines of code written in VAX-11 FORTRAN, a structured Digital Equipment Corporation extension of standard FORTRAN-77. Janus currently runs on any of VAX 11-780, VAX 11-785, or MICRO VAX II processors using four high resolution 9400 series RAMTEK graphic systems configured as single view controllers. The hardware for a complete MICRO VAX II based system costs slightly less than $250,000.

E-II-2. Janus description. "Janus players plan and conduct tactical operations and make tactical and system employment decisions by using interactive graphics work stations. The players make decisions based on a continuous presentation of the battle on a map-like display and on-call status reports. The model includes most ground and air systems involved in offensive and defensive ground combat operations and is designated to handle wargame conflicts of up to Blue battalion vs Red regiment forces.

a. *Simulation type.* Technically, "Janus" is an interactive, two-sided, closed, stochastic, ground combat simulation. Interactive means that controllers or players direct, react to, and redirect certain key actions of the elements being simulated. Two-sided means that there are opposing forces simultaneously being directed by two sets of players. Closed means that the disposition of the opposing force is not completely known to the player in control of friendly forces. Stochastic means that certain events such as the result of a short or artillery volley are not predetermined but occur according to laws of probability and chance and may not

occur again if the game is repeated. Ground combat means that the principal modeling focus is upon those military systems that participate in maneuver and artillery operations on land.

b. *Model resolution*. "Janus" models individual systems moving, searching, detecting, and firing on the ground or in the air over a specified three-dimensional terrain representation. Each unit being simulated appears as an individual symbol on a graphic display of the terrain base whose separate parts include elevations, roads, rivers, cities, foliage, engineer barriers, and natural barriers.

c. *Terrain resolution*. Terrain resolution is variable and generally tailored to the particular study being performed. Standard resolutions used are 25, 50, 100, and 200 meter terrain grids. The digital terrain map displayed is 200 by 200 cells which allows terrain map display sizes respectively of 5, 10, 20, and 40 kilometers.

APPENDIX E

ANNEX III

AALPS

E-III-1. Introduction.

a. The AALPS is a knowledge-based expert system that assists users in the complex task of loading military cargo planes. This system grew out of the Army data distribution system (ADDS) testbed established by the Defense Advanced Research Projects Agency (DARPA) at Fort Bragg, North Carolina, in 1979. The Army users at Fort Bragg identified the need for an automated tool that could plan air loads and support deployment of them in real time. By using rapid prototyping and expert-system techniques, we were able to model the heuristic approach commonly used by aircraft load-planning experts.

b. Development of the currently fielded version of AALPS (using the UNIX operating system and Sun host processor) was begun in 1984 and completed in 1986. The system was approved for operational use by MAC in 1987. Systems were then purchased and fielded to various sites throughout the Continental United States (CONUS) in 1988. In 1989 the decision was made to make AALPS more widely available by transferring the system's functionality to an 80386 portable hardware platform. Efforts to perform this transfer are currently underway and the new system is scheduled for fielding in 1992.

E-III-2. Problem description. Constructing load plans for military transport aircraft is a complex problem that includes many factors. A transportation planner usually begins with a list of cargo items and a description of the mission the movement will support. When initial load planning begins, a best guess as to the models of aircraft that will be available is made and a set of loading arrangements is determined based upon the cargo, mission, and aircraft. When the planner constructs the load plan, numerous constraints must be accounted for. Each aircraft model has a set of cargo loading constraints that are associated with it including weight and balance constraints. Cargo items may also have constraints associated with them. For example, pallets must be loaded in specific locations. Constraints associated with the type of mission also come into play. Mission requirements may include whether the mission is strategic or tactical. With a strategic mission, making optimum use of the aircraft capacity is most important; with tactical missions, how the aircraft is loaded, speed of loading and offloading cargo, is the primary consideration.

E-III-3. AALPS functional architecture.

a. The architecture of AALPS was designed to serve four basic functions: automatic generation of valid load plans, generation/validation of user-defined load plans, user modification of existing load plans, and user tracking of movement statistics during an actual deployment.

b. With AALPS, a user specifies a list of equipment to be loaded, the types of aircraft that should be used, and selected mission parameters. For each aircraft, AALPS then outputs an arrangement of equipment that satisfies the equipment, aircraft, and mission requirements and constraints. Once at the airfield, the user can have AALPS display preplanned missions and replace planning parameters with real-world information obtained at the marshalling area (for example, changes in the type and number of aircraft that are actually available for the mission, actual vs planning weights for equipment, and the like). In this way, the system can alter and revalidate the planned loads that were generated earlier.

c. The four functionalities discussed above are provided by five main programs: the automatic load planner (ALP), the typeload editor (TLE), the item data base (ITEMDB), the enter list file (ELF), and the aircraft data base (ACDB). Figure III-1 shows the AALPS functional architecture.

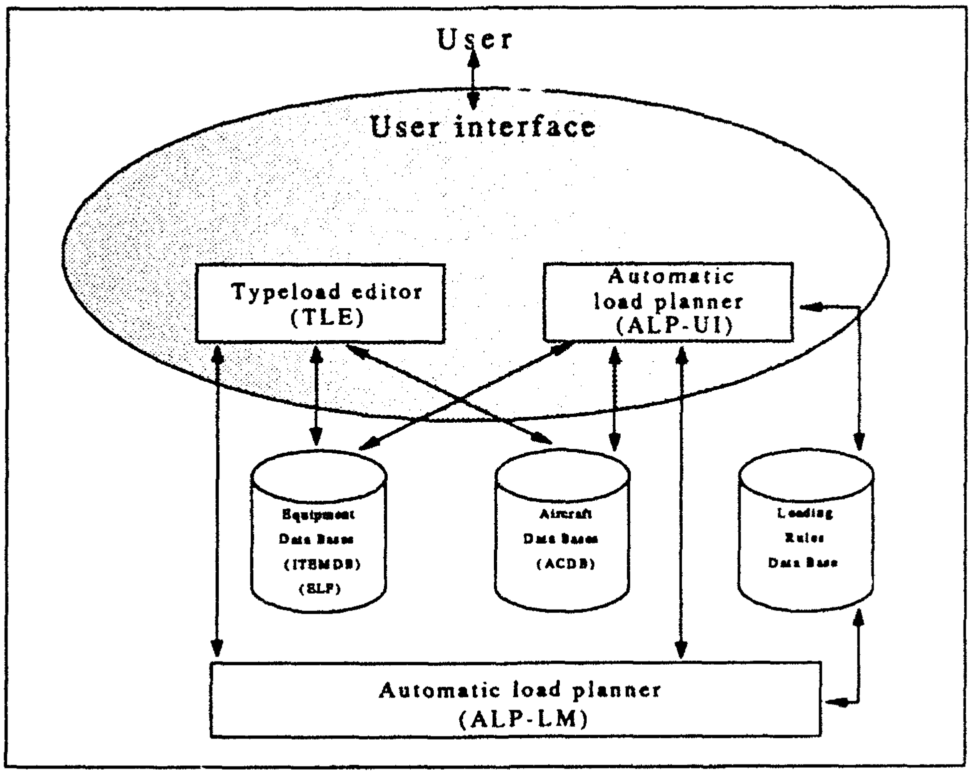

Figure E-III-1. AALPS functional architecture

(1) The ALP program supports the automatic generation of load plans based on user input parameters and cargo. Within the ALP, there are two main modules, the User Interface (ALP-UI) and the Loading Module (ALP-LM). The ALP-UI provides a "friendly" interface between the user and the ALP-LM. The ALP-UI supports user entry of load planningparameters including cargo lists, aircraft models, and mission requirements. It also provides an output module that presents load planning results and allows the user to save those results for future use. The ALP-LM contains the procedural knowledge used to generate valid aircraft load plans. Coupled with the ALP-UI, it supports automatic generation of aircraft load plans. The ALP-LM

is a collection of rules and operators describing the process of load planning. This information is used to determine where each cargo item should be loaded. Part of the ALP-LM includes a rules data base that stores modifiable rules about aircraft loading.

(2) The TLE is a graphics-oriented application program. The TLE is used primarily at the time of deployment, when actual cargo characteristics are known with certainty (for instance, axle weights, center of gravity, and so on). The TLE presents a graphical image of a load plan where a user can select an item and graphically manipulate its location and dimensions. Load plans that are altered are revalidated by the system. In addition, the TLE can provide movement statistics about a particular group of aircraft. Information about which aircraft, cargo, and number of personnel that have departed vs those that are "on-hand" is maintained within the TLE.

(3) The ITEMDB program supports an equipment data base that contains detailed information about the cargo items including complete dimensional information and special loading requirements.

(4) The ELF program supports users equipment-list data bases that contain user created lists of cargo that represent logical groups or missions that are often loaded together. This data base allows the user to specify to the ALP program a list of equipment to load using a single identifier as opposed to inputting each individual item. In addition, users frequently create many lists in advance to plan for contingencies.

(5) The ACDB program supports an aircraft description data base that contains detailed characteristics of each aircraft model, including dimensional information, loading constraints, and special loading requirements.

E-III-4. ALP-LM rule structure and use.

a. As mentioned earlier, the ALP-LM contains the procedural knowledge used to generate valid aircraft load plans. In developing the ALP-LM software, engineers met with Air Force expert load planners to understand the processes and gain insight into how best to approach the problem. The ALP-LM was developed incrementally where frequent meetings with the experts were held to evaluate the system as it evolved. The ALP-LM's structure very closely models the methods used by human experts.

b. The ALP-LM performs its load-planning process by transforming an initial state, consisting of a set of cargo, aircraft models and mission requirements, into a final goal state where a set of valid load plans is produced. To achieve this state transformation, the ALP-LM is comprised of three major components: evaluators, operators, and rules. Figure III-2 illustrates the control flow of the ALP-LM.

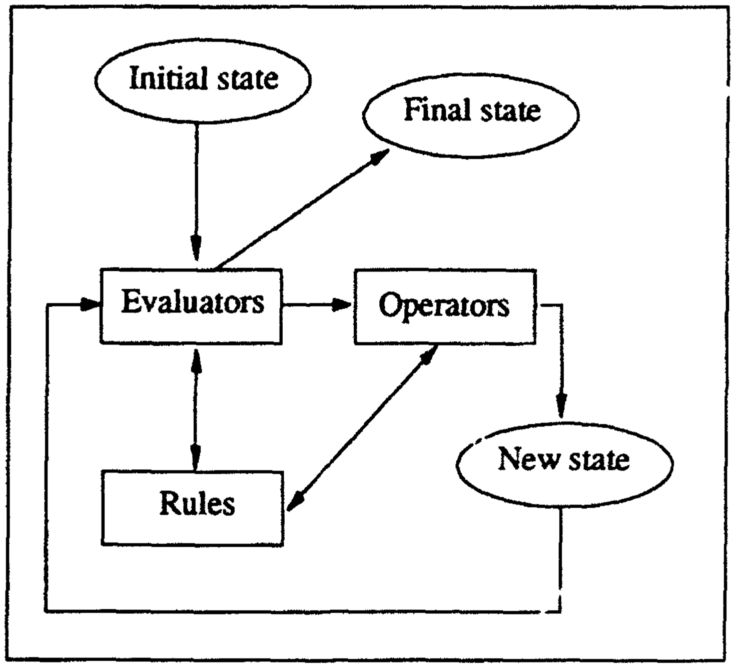

Figure E-III-2. ALP-LM flow diagram

(1) Evaluators. The ALP-LM performs its state transformation by first evaluating the current state of the load-planning process. Evaluators are the part of the load-planning system that perform this process. Once the evaluation has been completed, the evaluator will select an operation to perform. Examples of evaluators are as follows: Is there room on the aircraft for additional cargo? Are there seats available on this aircraft? Is this load balanced?

(2) Operators. Operators perform basic operations on the state of the load plan. When an operator is called, it will transform the state of the load-planning process into a new state. If the operator selected does not improve the overall situation, the actions associated with the operation are undone, and the evaluator that selected the operation will choose another operator to try. Examples of operators are the following: fill seats with passengers, slide loaded cargo, pick a cargo item to load, and balance the aircraft's cargo load.

(3) Rules. The ALP-LM captures the domain knowledge of expert load planners in the rule base, and AALPS stores these rules in its data bases. Both evaluators and operators call upon the rule bases for guidance in performing their functions. In general, the rules describe either a process or requirement. Examples of rules that describe a process are as follows: Balance the load first, then validate constraints; once the load is constraint free, load personnel on the aircraft; when a valid load configuration is found, see whether copies of the load can be made. Examples of rules that describe a requirement are as follows: palletized cargo should not be mixed with vehicular cargo, all aircraft must be balanced, and all aircraft must be constraint free.

APPENDIX E

ANNEX IV

FASTALS

E-IV-1. Introduction.

a. There is a tool available that will compute the logistics workloads for planning theater support unit requirements in a relatively short period of time. The tool is the FASTALS model in current use at the U.S. Army Concepts Analysis Agency (CAA) in Bethesda, Maryland, the Department of the Army System Proponent for FASTALS. Companion stand-alone versions of FASTALS are operated and maintained by the Simulations Divisions of the Operations Analysis Directorate, U.S. Army Logistics Center (LOGCEN) in Fort Lee, Virginia, and the U.S. Army Logistics Evaluation Agency in Cumberland, Maryland.

b. Use of FASTALS can eliminate many long hours of manual computations and will afford the planner additional time to analyze many different facets of a force. Further, FASTALS will enable the planner to examine in detail the effects of perturbations in selected parameters for sensitivity analyses.

c. The FASTALS model has been used extensively in the preparation of input for the Army Program Objective Memorandum (POM), the Army contribution to the Joint Strategic Planning Document Analyses, and many other studies. The results produced have been widely accepted throughout the Army Staff.

d. Although the FASTALS model was developed as part of the Force and Weapons (FOREWON) System, it is primarily used in force planning analyses where balanced, time-phased, geographically distributed force requirements are desired. Given a tactical situation, logistics capabilities, and theater policies, FASTALS can be used to determine the total force necessary to support the situation logistically. An advantage in FASTALS is that the force planner's time is available for analysis of alternative forces instead of long, drawn out, computational exercises.

E-IV-2. Background.

a. FASTALS was developed in 1971 by the Research Analysis Corporation as a part of a large system of models known as the FOREWON System. As used in a typical study, FASTALS is part of a system of integrated models as shown in figure E-IV-1. Given a specific scenario and defined force, the Transportation Model (TRANSMO) computes deployment schedules based on movement requirements in terms of tonnage, cargo types, and available transport. The warfighting model then computes the combat results based on a supplied scenario and the force movement schedule of TRANSMO. Two warfighting models

are available at CAA: the Concepts Evaluation Model (CEM) and A Tactical, Logistical, and Air Simulation (ATLAS) model. The CEM provides a more detailed set of results. FASTALS, using the warfighting results, a Scenario, and a Master File of available units, computes the support force requirements necessary to round out the combat force. The primary input files to FASTALS are the Scenario and Master File, and will always be referred to in capitalized form as shown. FASTALS output is compared to the original force definition in a matching process to check the availability of the roundout force. As a final step, the roundout force is checked against the deployment schedule defined by TRANSMO. FASTALS outputs are further analyzed (depending on the particular study) by a system of postprocessors. The particular postprocessor selected depends on the study objective which can be force design, costing, stratified personnel requirements, materiel requirements, etc. Final results are used in support of Army force planning analyses.

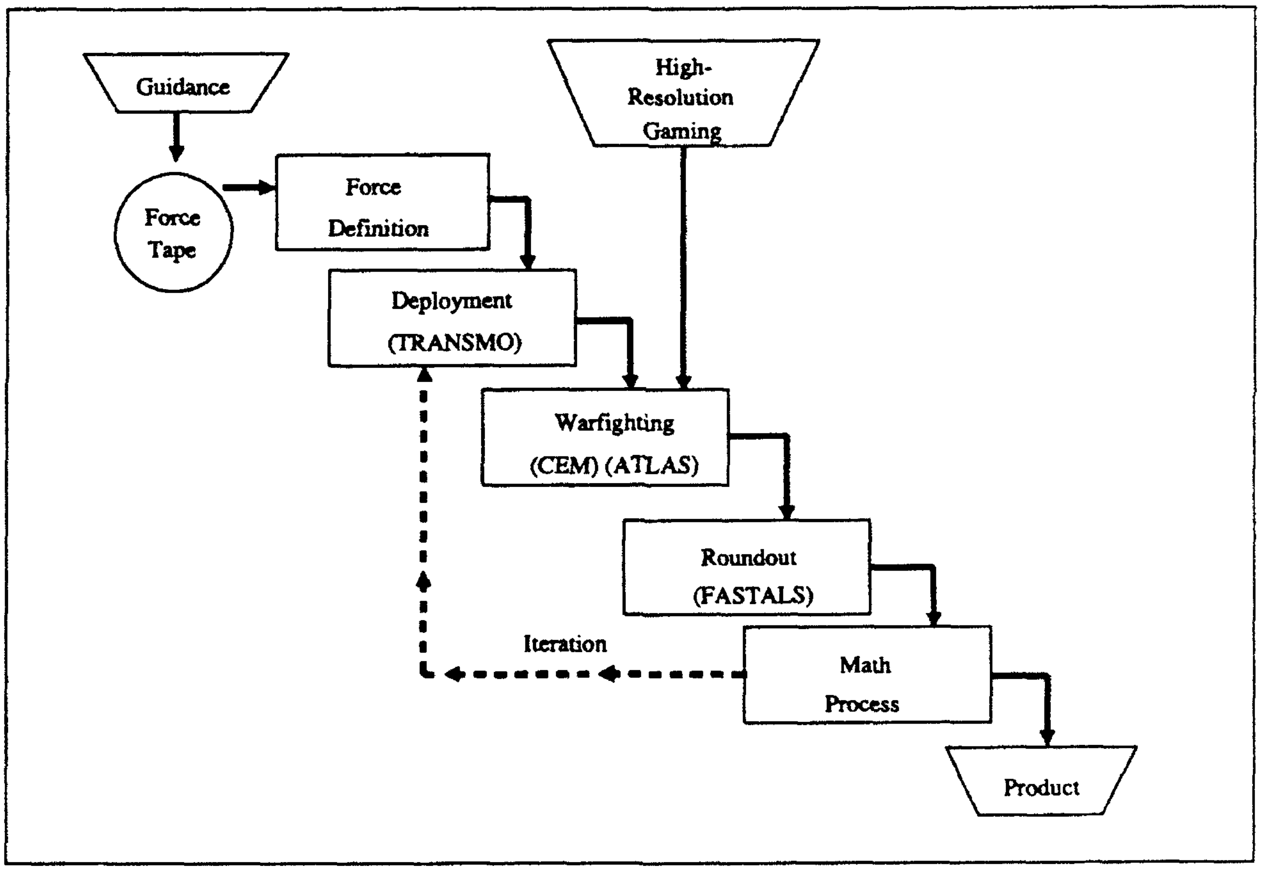

Figure E-IV-1. A system overview

b. FASTALS has been used in a wide range of studies in support of the Army Staff and the major Army commands (MACOM).

(1) Force structure analysis. The majority of the applications are for the purpose of reviewing the current or programmed force in support of Office, Deputy Chief of Staff for

Military Operations requirements. These studies include Total Army Analysis (TAA) and the U.S. Army Operational Readiness Capability Analysis.

(2) Crisis reinforcement excursions. The model has been used to estimate the support force required when a force is to be deployed in a reinforcement action to areas other than where U.S. units are currently positioned. The primary purpose in these excursions has been to estimate the total lift requirements for such an exercise.

(3) Doctrinal investigations. FASTALS has been used to estimate the force structure implications of proposed changes in support concepts and doctrine. New military police allocation rules proposed by TRADOC and a new ammunition handling structure proposed by the Army Missile and Munitions Center and School are typical excursions which have been carried out using FASTALS. TRADOC performs these excursions at the LOGCEN.

(4) Equipment changes. The total support force implications resulting from adding new equipment, such as the multiple rocket launcher system, have been estimated using FASTALS.

E-IV-3. Approach taken by the FASTALS model. In the system described in paragraph E-IV-2a, the model that was of greatest interest to logisticians was FASTALS, which was and is unique for several reasons. First, it automated the computation of a balanced and time-phased trooplist based on a given combat force and its theater-related activities. The resulting trooplist consisted of the number of units required to provide complete support (based on the TOE capabilities of the units involved). Second, it located units and their workloads in the division, corps, RCZ, communication zone (COMMZ), and port areas. Third, the model calculated 48 different logistics workloads and allocated units to perform them. Workloads computed pertain to personnel, replacement, medical, materiel, maintenance, construction, and transportation functions. As an indication of the level of detail considered by FASTALS, the scenario input deck for a typical FASTALS run includes the data elements shown in table E-IV-1.

Table E-IV-1. Scenario data elements (sequences)

```
- Identity of major ground combat units.
- Deployment schedule and destination of those combat units.
- M-day stationing of divisional and nondivisional artillery by
    type.
- Intensity of daily combat activity (intense, moderate,
    reduced, or reserve) for each unit.
- Location of the forward edge of the battle area (FEBA).
- "Map" of the theater (regions and sectors).
- Length and number of time periods.
- Percentage of construction by construction task to be
    accomplished by time period.
- Tons and location of prepositioned equipment and supplies in
    the theater.
- Facility assets by location and percentage available for U.S.
    Army use.
- Extent of materiel maintenance to be performed in the theater.
- Stockage policy and objective in days; replacement and
    buildup.
- Divisional and nondivisional consumption rates.
- Description of transportation network with individual segment
    capacities (percentage for U.S. use) by time period.
- Medical evacuation policy and wounded in action and disease
    nonbattle injury rates (divisional and nondivisional).
- Prisoner-of-war capture rates and control policy.
- Master File containing all the data by SRC necessary to
    allocate units, to compute unit-dependent requirements, and
    to furnish the technical data necessary to drive the model.
- Support to be provided for other services or allies.
- Degree of use of indigenous (labor service and host nation
    support labor.
```

a. *Step 1.* Consultants from the Army Staff and MACOMs (Signal, Medical, Transportation, Engineer, Infantry, etc.) provide input for producing the FASTALS scenario. The planner's input sources may come from defense guidance, Army Force Planning Data and Assumptions, doctrinal publications (FMs or TOEs), MACOMs and subordinate agencies, the study sponsor, or the Army Staff. An important portion of the scenario is the sequence containing the Master File (actually the 30th sequence of the scenario). It is usually prepared separately from the scenario as a separate data file. It consists of between 4 and 5 thousand card images. Five card images are used to fully describe each unit that may be used to round out the force of a particular FASTALS run.

b. *Step 2*. Operation of the FASTALS main model produces a balanced trooplist. The unit Master File is examined by considering the requirements of each type unit in turn and incrementing workloads as additional units are added to the trooplist. Each examination is caulked a cycle, or iteration. In cycle 1, combat units (divisions, separate brigades, and ACRs) are brought into the theater and augmented by units allocated on the basis of existence

rules, or specific details describing the theater structure (e.g., a unit allocated on the basis of one per division or one per corps, etc.). In successive cycles, units that are required because of the workloads generated by the previously allocated units are added to the trooplist. The cycling or interactive process is completed when trooplists developed in two successive cycles are identical.

c. *Step 3*. Force structure analysts or staff specialists review the trooplist to ensure that doctrine concerning organization, operational capabilities, and system integrity was followed. Usually, CAA is assisted in this review by Army Staff specialists in fields such as Special Forces, Civil Affairs, Military Intelligence, Public Information, and Air Defense. Should they find inconsistencies, corrections are made to the data and the program is run again. Various reports can be produced from the theater trooplists to assist in analysis.

E-IV-4. General model description. The purpose of the FASTALS model is to compute administrative and logistical workloads and to generate the theater-level support force structure requirements necessary to round out a combat force in a postulated confrontation. FASTALS may be used in any fore planning simulation to develop a force that is balanced, time-phased, and geographically distributed. A trooplist is said to be balanced when the individual units comprising the list are capable of accomplishing the various workloads generated by the total force. Trooplists are said to be time-phased when unit requirements are prescribed for each time period in the simulation. Support to combat units is defined as the logistical and administrative service support necessary to support a tactical activity. The major elements of support are maintenance, construction, supply, transportation, hospitalization and evacuation, and personnel replacement. Requirements for units performing these functions are derived from workloads which are generated as a function of the combat force deployment, theater structure, and the tactical operations as developed in the warfighting model.

a. *Input*.

(1) The Master File. A unit file, normally ordered by SRC, contains the data necessary to allocate units and to prescribe unit support requirements. The Master File also included additional technical data necessary to drive the allocation logic of the model, and unit weight, strength, location, and computational logic, as required.

(2) The Scenario. The following data are the major variable input generating the Scenario File which, when combined with the FASTALS Master File, generate the statement of support force requirements.

(a) Combat simulation data. The FASTALS model uses the results of the combat simulation, such as CEM, or the ATLAS model as the starting point for a roundout process. The combat results may be developed from a manual combat simulation or input on a file created by processing the results of an automated warfighting analysis. Combat data required for the FASTALS simulation include identification of all factors related to combat units including strength, location, and identification number; the deployment of these units; the

location of units within the theater; and the level of combat activity of each unit by day expressed as intense, normal (or moderate), reduced, or reserve. These data define the basic support parameters of the combat units.

(b) Theater of operations. In order to simulate a theater of operations, the user must provide data defining the theater geographically by time period. The geographical aspects of the theater vary by time period and are defined by sectors and regions. A typical theater description is portrayed in figure E-IV-2. The theater typically consists of 21 physical regions organized into six logical regions (LR) and three sectors. A sector is a portion of the theater that contains a unique axis of logistic activity. Thus, each sector is considered independent of other sectors regarding logistical activity, and support units are therefore, allocated on this premise. A unit assigned to one sector cannot use any excess capability to fulfill support requirements in an adjacent sector. Thus, the number of sectors in a theater can have a significant impact on the number of support forces required for a given combat simulation. Physical regions serve as a basis for locating the position of activities, such as FEBA movements and location of prepositioned supplies and equipment within the theater. Common physical regions (19, 20, or 21) denote areas located in the support axis of more than one sector. Common physical regions are usually used to represent the base echelon in a theater. The location of physical region boundaries is determined primarily by two factors. First, physical regions can be controlled by only one of the opposing forces, and the FEBA cannot be positioned in the middle of a physical region; thus, the depth of the physical region determines the resolution of the FEBA. Second, the FASTALS model simulates the theater transportation activity by tracking the movement of units and supplies between regions; thus, the transportation network is governed by the number of physical regions designated within the theater. The desirable features of a large number of physical regions with the resulting high FEBA resolution must be weighed carefully against the increased amount of input data necessary to define the transportation network, as well as the additional computer time to process data. Generally, the depth considered adequate for a region is that distance required to accommodate an Army criterion such as a corps or a division. The LR corresponding to the echelons of the Army structure are: LR 1 represents the division area; LR 2 and LR 3 represent the corps area; and RCZ, LR 4, and LR 5 represent the COMMZ and port areas; and LR 6 represents offshore facilities, or in the extreme, CONUS. Each echelon in the theater of operations in any time period is specified by superimposing the applicable LR over the specified physical region.

(c) Prepositioned equipment. Since the unit deployment weight has a significant impact on the transportation workload, all prepositioned organizational materiel configured to unit sets (POMCUS) in the theater are input to FASTALS. This equipment, expressed in tons, is positioned by physical region. This area is the same location to which the units will deploy rather than the area where the equipment may be actually stored. Available prepositioned equipment will be credited against the unit deployment weight, thereby reducing the unit equipment workload placed on transportation units.

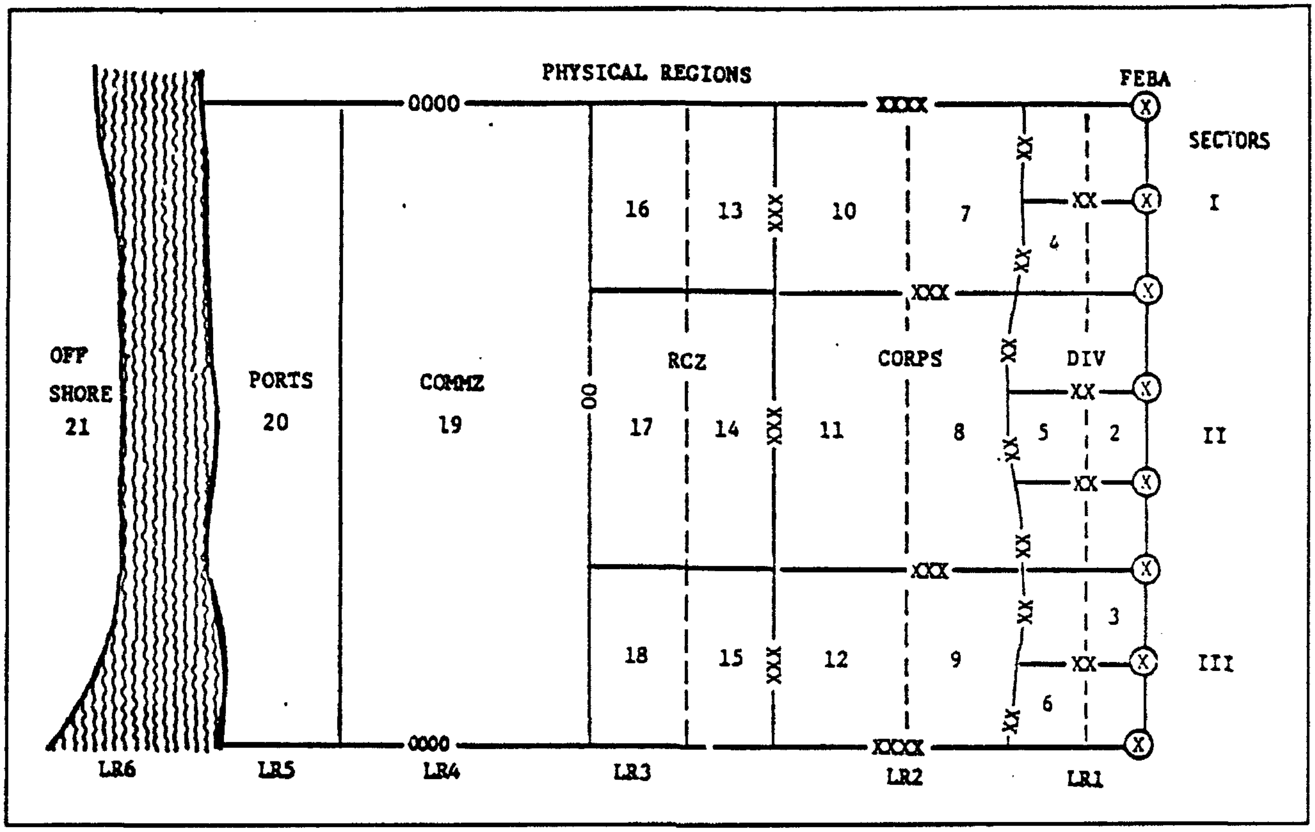

Figure E-IV-2. FASTALS theater map

(d) Prepositioned war reserve materiel stacks (PWRMS). Theater reserve stocks, expressed in STONs, are distributed where stored within the physical regions of the corps, RCZ, and COMMZ. By locating the theater reserve stocks in this manner, and in accordance with anticipated usage, creation of unrealistic demands by the model for resupply from CONUS during the early stages of the conflict is averted. Available prepositioned stocks will be credited against unit consumption and stockage requirements within a sector and thereby eliminate a false workload that would have been put on port handling and transportation units.

(e) Engineer support requirements. Construction requirements computed in FASTALS are essentially those activities performed by the engineer combat battalion (heavy). Existing facilities within a theater will be used wherever feasible. These existing facilities are input as construction assets in each physical region and will offset the need for some quantity of construction effort. There are 23 engineer tasks and associated workloads. The model computes the manhours required for each of those tasks per time period. In actual practice, not all the tasks would have equal priority. Therefore, the planner inputs engineer task completion percentages (construction policies) for each time period. Construction of administrative space, for example, could be deferred during the early time periods so that increased effort could be devoted to such tasks as repair of road damage or port maintenance.

(f) Supply data. Within FASTALS, the materiel routine produces the consumption and stockage requirements for each class of supply in the simulated theater. Divisional consumption is based on consumption factors, expressed in pounds per man per day, input in the form of combat consumption tables for each intensity of combat (intense, moderate, light, and reserve). Combat consumption derived from warfighting analyses, or other sources, may be used instead of data described above. Similarly, nondivisional unit consumption is based on consumption factors input by a table, except that all consumption is at uniform rate (moderate) rather than by intensity. To calculate the level of supplies to be stocked in each physical region of the theater, the supply planner inputs supply policies given in numbers of days of supply. In addition to determining the level of stocks, the user also specifies the stocks required at each echelon (division, corps, RCZ, and COMMZ). For each unique stock level (e.g., a 30-day supply level) that is required, the planner must input a matrix indicating the required distribution of these stocks.

(g) Transportation data. Transportation is a significant aspect because of the number of workloads to which it contributes, the number of units that are allocated based on transportation workloads, and the amount of input required. As shown in figure E-IV-3, the transportation network consists of links (notional representations of connections between two points on a map) and paths (series of links) which are assigned transportation modes (highway, pipeline, and railroad, etc.). The primary function of the transportation network is to simulate the movement of supplies from one physical region to another and to distribute the movement requirements between the available modes. Movement requirements are a result of consumption and stockage requirements, as well as nonmobile unit equipment movement requirements and are therefore sensitive to the following variables:

-- Deployment of combat units as depicted by the warfighting simulation.

-- Consumption of ammunition as depicted by the warfighting simulation.

-- Consumption factors for all classes of supply.

-- Stockage objectives and supply buildup policy.

-- Level and location in the theater of (PWRMS).

-- Model description of the theater, in terms of divisional, corps, and COMMZ boundaries.

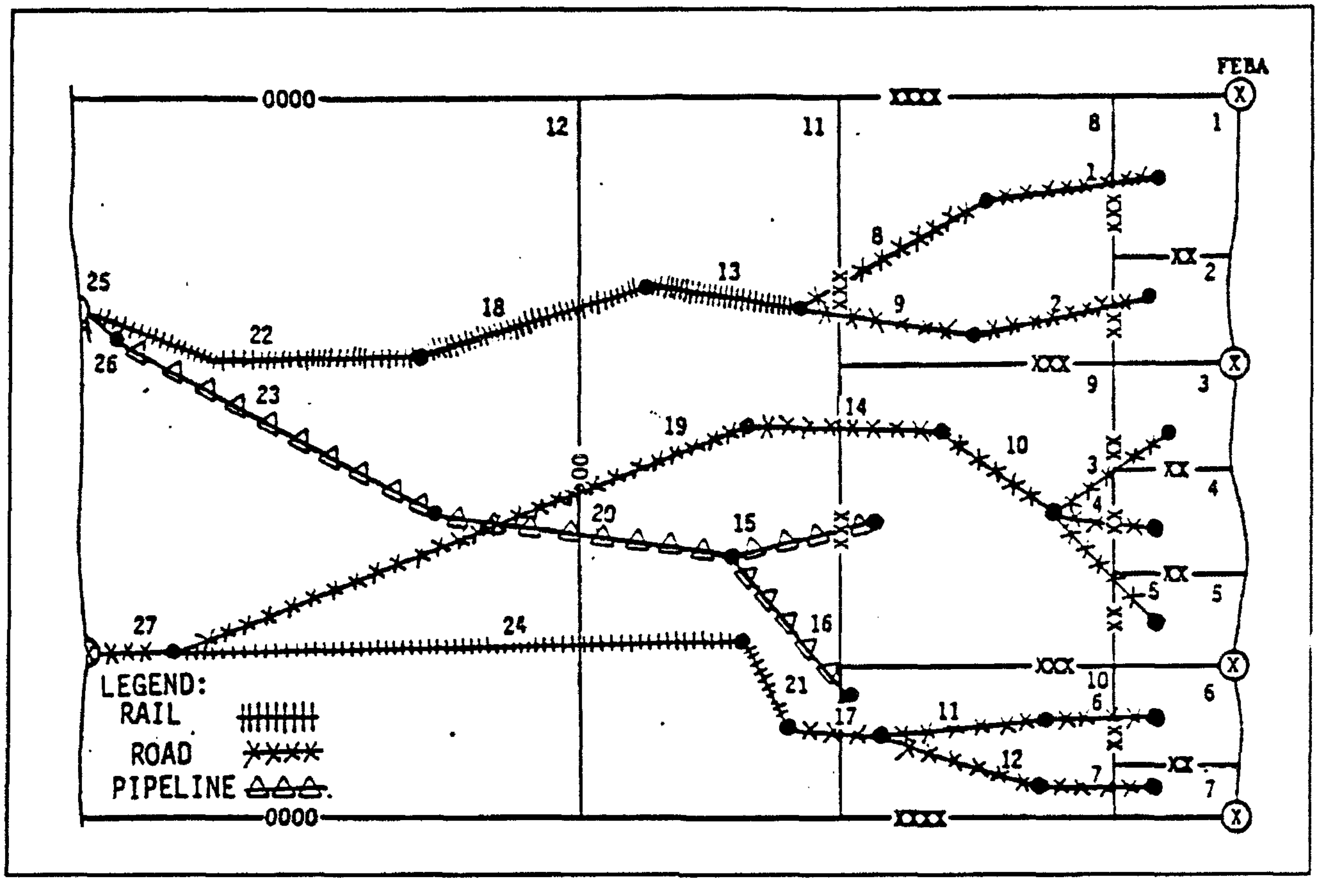

Figure E-IV-3. Transportation network

(h) M-day units. Another data element necessary to describe the theater of operation is a list of units in the theater at mobilization (M-day).

(i) Additional data. Additional scenario-oriented data includes length and number of time periods, damage factors, wounded and diseased and nonbattle injury admission rates, and enemy prisoner-of-war capture rates.

b. *Execution.* The force structuring problem is as follows: given a tactical situation in terms of unit deployment, logistic capabilities, and policies, determine the total force that is necessary to support the situation logistically. Figure E-IV-4 depicts the flow of logic which FASTALS uses to solve this problem.

(1) Allocation cycle. First, the combat units used by the combat model are augmented by direct input units and by units that are implied by the organizational structure of the theater being analyzed (e.g., number of corps). Next, units that are required on the basis of the existence of other units in the theater are added to the list. The model then computes workloads generated by these units in terms of personnel replacements, hospital admissions, supplies, maintenance, construction, and transportation. These workloads are then

used as a basis for adding more units such as hospital and medium truck companies. This new set of units generates another increment, and so the cycling process begins. Additional units increase the workloads which, in turn, generate a requirement for more units. This cyclic process, steps 5 through 13, is continued until the model computes the same set of units (trooplist) that was computed on the previous cycle. Table E-IV-2 lists the workloads explicitly estimated in the model.

(2) Profiling. The FASTALS model incorporates a technique know as profiling to modify the computed requirement for a unit during any stage of theater force development. It is most accurately construed as the quantification of the theater commander's judgment in modifying doctrinal requirements for any given unit at a given stage of theater maturation. Logically this would be manifested during the early part of the war as a combat heavy force with an extremely austere support structure. During this early stage the theater commander would deliberately opt to "do without" much doctrinal support (eat C rations rather than A rations, evacuate casualties rather than treat in country, etc.). Later, the force would be doctrinally "rounded out" as the theater matures. Pursuant to the "requirements" philosophy of FASTALS, real world constraints, such as lift limitations, are not normally the motivating considerations in profiling.

Table E-IV-2. Workloads

Workload No.	Description
1	U.S. Army population in thousands
2	1,000 STON dry cargo/unit equip seaports/day
3	1,000 manhours engineer const/day
4	1,000 manhours nondiv DS auto maint/day
5	1,000 manhours general spt automotive maint/day
6	1,000 STON-day cargo/unit equip thru afld/day
7	1,000 STON class 5 stock change/day
8	1,000 STON ALOC class 9 issue/day
9	1,000 STON bulk POL moved by truck/day
10	1,000 manhours power generated equip maint/day
11	1,000 STON dry cargo (less Class 5) stored
12	1,000 manhours div AVIM/day
13	1,000 manhours nondiv AVIM/day
14	1,000 hospital beds in theater or COMMZ
15	1,000 enemy PW and civilian internees
16	1,000 STON class 5 consumed/day
17	1,000 STON bulk class 3 stored
18	1,000 STON hrs dry cargo & unit equip/truck/day
19	1,000 replmts thru replacement camps/day
20	1,000 STON dry cargo transshipped/day
21	1,000 STON bulk class 3 issued/day
22	U.S. Army nondiv pop in thousands
23	1,000 STON general supplies issued/day
24	1,000 STON class 5 stored
25	1,000 STON general supplies stock change/day
26	1,000 STON dry cgo & unit equip/inland wtrwy/day
27	1,000 STON classes 1 and 6 consumed daily
28	1,000 STON unit equip disch at ports/day
29	1,000 manhours of divisional DS auto maint/day
30	1,000 STON hrs unit equip moved by truck/day
31	1,000 manhours tank automotive maint/day
32	1,000 manhours tank turret maint/day
33	1,000 manhours artillery automotive maint/day
34	1,000 manhours artillery armament maint/day
35	1,000 manhours small arms maint/day
36	1,000 manhours light armor automotive maint/day
37	1,000 manhours construction engr equip maint/day
38	1,000 manhours field radio maint/day
39	1,000 manhours SIGINT/EW maint/day
40	1,000 manhours special devices maint/day
41	1,000 STON class 2 supplies consumed/day
42	1,000 STON class 3 (pkg) consumed/day
43	1,000 STON class 4 consumed/day
44	1,000 STON class 7 issued/day
45	1,000 STON class 8 consumed/day
46	1,000 STON class 9 (non-ALOC) issued/day
47	1,000 STON water consumed/day
48	1,000 STON class 1 supplies stored

(3) Logistic constraints. Being a separate and distinct model in the force development methodology, FASTALS' statements of support unit requirements do not directly affect the capability of the combat force to carry out its mission in the warfighting model. Only if the support function is specifically modeled, and the deployed capability to perform the function is properly specified, can logistic constraints be properly considered by the combat model.

c. *Output reports*. In addition to the unit deployment schedule (trooplist) which is specified by SRC, unit description, location, strength, weight, and time-phased requirement, the FASTALS output also includes time-phased reports listed by theater location (see table E-IV-3). Some of the reports provide the consumption and stockage requirements for each category of supply and the tonnage carried over each link in the transportation net. Other reports described the type of transportation used and the type of materiel hauled; the engineer construction requirements by type; the number of DS and GS manhours of automotive maintenance required; the number of hospital beds in the theater; the number of casualties and replacements generated; and the population in terms of combat troops and nondivisional troops.

Table E-IV-3. FASTALS output

- Stock status
- Consumption
- Construction requirements
- Workload summary
- Nondivisional personnel losses
- Time-phased troop deployment list
- Transportation analysis
- Branch summary
- Unit tonnage report

E-IV-5. System configuration. The FASTALS model is maintained by CAA and the LOGCEN. The program is available to users through coordination with the above agencies. This model has been developed for use on UNIVAC 1100 Series computers and modified versions are available for Control Data and Digital Equipment computers.

E-IV-6. Limitations. The FASTALS model's limitations are primarily due to the complexity of inputs to the Master File and Scenario. All data must be enter in prespecified order and must agree in context via cross reference.

E-IV-7. Processing time. The processing time is directly related to the size of the scenario developed by the planner. At CAA, processing time averages about 30 minutes. About two-thirds of this is devoted to input/output operations.

APPENDIX E

ANNEX V

TAFCS

E-V-1. TAFCS was developed under contract by the U.S. Army Cost and Economic Analysis Center to be dynamic cost estimating/analysis working aids to assist the force cost analysis in developing force unit cost estimates for an array of cost estimating scenarios. The application provides the capability to retrieve the official and most current U.S. Army cost estimating data.

E-V-2. TAFCS is made up of two components. The Force Cost Model (FCM) which provides the unit level total costs of materiel, personnel, and operation; and the Exportable Force Cost Data base (EFCDB) which provides detailed unit costs and data on separate items of equipment or operations.

E-V-3. The FCM is accessed by SRC (or TOE number) and produces cost estimates for acquiring materiel and personnel for a force unit; activating a force unit; and operating a force unit. The estimate can be tailored based on input variables such as geographical location, authorized level of organization, training readiness, component, and base year dollar. The quantities of inherited assets, materiel that already exists in the Army, can be varied. Outputs include the estimates, equipment cost drivers, operational tempo (OPTEMPO) data, personnel, and costs by appropriation.

E-V-4. The EFCDB provides the FCM all individual cost data for compilation and provides the facility for analysis of item costs separately.

E-V-5. The TAFCS is a personal computer-based system that allows the user to calculate operating and procurement costs for standard TOE units. Units are assumed to be at the designated levels of authorization and operating at the currently programmed OPTEMPO. The model compiles data from the Operating and Support Management Information System, Battalion Level Training Model, Army Manpower Cost System, logistics data files, Army cost positions for major weapons systems, and budget justification books. TAFCS also uses independent estimates where other data is not available.

E-V-6. The basic data files are in the FY constant dollars, at the time of compilation. For example, the data in version 1.0 of the TAFCS is in FY90 constant dollars. The models escalate to any year dollars by standard DoD inflation factors.

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APPENDIX F

COST FINDINGS

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APPENDIX F

COST FINDINGS

F-1. Introduction.

a. In July 1990, the Commanding General of TRADOC directed the evaluation of a corps-level reconnaissance, surveillance, security, and screening force. He further directed that the Armor, Aviation, and Infantry Schools prepare the organizational concept and Unit Requirements Sheet (URS) level design for the alternatives for which they have proponency. The study sponsor requested a force cost analysis be performed to evaluate a base case force structure and the alternative forces. TRAC-TOD directed TRAC-WSMR to perform the force cost analyses to determine the comparative force costs for the different corps-level, regiment-type forces.

b. This appendix contains the force cost analysis conducted in support of the AGMC evaluation. The analysis evaluates an ACR size force and four prototype forces, some of which include future developmental combat systems.

c. Force cost analysis seeks to take a defined force structure (unit or units) and detail the equipment and personnel requirements to provide the nonrecurring (acquisition) costs and recurring (operating) costs for 20 years. These costs, when combined, represent the total force cost of the studied force.

d. Force cost and logistics support costs are addressed for the base case and for each of the alternative forces, with focus on essential missions and mission support equipment, and personnel by officer, warrant officer, and enlisted categories. The current ACR serves as the base force structure for developing force costs for the alternative forces. Force costs for the different force structures are based upon data obtained from TAFCS. Equipment unit costs not found in TAFCS were obtained from life cycle costs estimates (LCCEs)/baseline cost estimates (BCEs) for the developing systems on-hand at TRAC-WSMR or from the Army Materiel Command (AMC) project managers.

F-2. Study objective. The AGMC related study issues were translated into study objectives and EEAs. The objective was to determine and present the force and logistics cost impacts associated with the selected equipment and personnel of the base case force and each of the alternative forces. Specifically, the cost analysis for AGMC addresses:

-- What are the force costs for the base case and for each of the four alternative forces?

-- What are the costs for the logistics support required at echelons above brigade/regimental level to support the base force and each alternative?

F-3. Assumptions/ground rules. These assumptions and ground rules for AGMC cost analysis were used to ensure comparability:

-- The TAFCS will be used where possible for the force cost data.

-- Costs not found in TAFCS were obtained from current data on hand at TRAC-WSMR or AMC.

-- All costs are presented in FY92 constant dollars.

-- All forces are to be costed at the same levels of detail.

The level of detail to be considered is:

-- Equipment lists will include essential mission and mission support equipment only.

-- Personnel costs are not included in the decision costs. However, since personnel [mostly military pay and allowances (MPA)] represent a large proportion of recurring costs, the numbers of categories of personnel, as well as the cost are used in the sensitivity analysis for comparison of the forces.

F-4. Logistics and personnel impacts. TRAC-LEE provided the CSS units as the logistics force to support the base case and the alternatives from the LIA results. The following additional CSS units are required (table F-1). These units are required over and above the CSS that is now fielded in support of the current Army forces.

Table F-1. Additional CSS units

Unit	SRC	ACR	MACR	AIRCR	LCR	MIB
Veterinarian detachment	08419L0	1	1	1	1	1
Preventative medicine detach	08498L0	1	1	1	1	1
Finance team	14413308	1	1	1	1	1
JAG team	27512L0	1	1	1	1	1
Maintenance company	43209L0	2	2	2	1	1
Wheel repair team	43509LG	4	4	4	4	4
Trailer transfer point	55540LE	2	2	2	2	2
Medium truck company (cargo)	55728L1	1	1	1	1	1
Medium truck company (water)	55728L1	1	1	1	1	1
Medium truck company (petro)	55728L2	2	2	2	1	1
Terminal service	55827L0	1	1	1	1	1
Repair parts company	42419L0	0	0	0	0	0
Total spaces			1,584		1,207	

Personnel authorizations for the study forces and CSS units are presented below in table F-2.

Table F-2. Personnel authorizations

Unit	Unit O/W/E	CSS O/W/E	Total Unit	Total CSS	Total all
Base case					
Armored cav regt	287/132/4282	44/15/1525	4701	1584	6285
Alternatives					
Modified AR cav regt	287/166/4203	44/15/1525	4656	1584	6240
Air cav regt	252/284/3296	44/15/1525	3832	1584	5416
Light cav regt	298/175/4024	35/09/1163	4497	1207	5704
Motorized inf bde	310/154/4487	35/09/1163	4951	1207	6158

F-5. Cost methodology.

a. The URS listings of personnel and equipment were provided for the analysis by TRAC-OAC.

b. TAFCS, with its FCM and the EFCDB, was used to provide the costs of the units and equipment that could be identified by SRC and/or LIN once the URS listings were received.

c. The FCM, version 1.1, was used for the units identified by SRC. The EFCDB, version 3.1, was used for equipment and/or surrogate equipment identified by LIN and/or SRC.

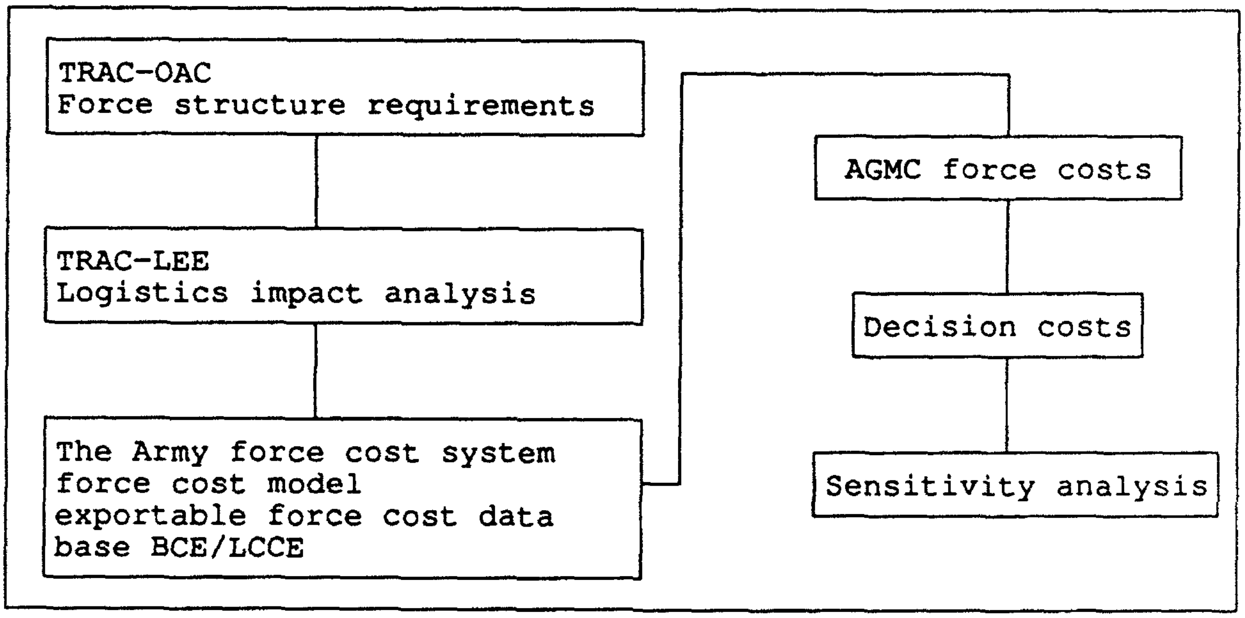


Figure F-1. AGMC force cost methodology

Unit costs not found in TAFCS (such as the AGS, the Future [illegible]ut Vehicle, the Block III tank, etc.) were obtained from data on-hand at TRAC-WSMR in BCEs/LCCEs obtained for system cost and operational effectiveness analyses, cost and training effectiveness analyses, and other studies. The unit cost from the BCE or "flyaway cost" and sustainment costs (5.01 and 5.02) were used for the study. Table F-3 presents the source of those items for which costs were not obtained from TAFCS.

Table F-3. Developmental cost data sources

System	Source	Date
Block III tank	TACOM BCE	May 1990
FSV(C)	TACOM ROC dev	November 1990
FSV(S)	TACOM ROC dev	November 1990
AFAS	USAFACS	June 1991
LH	AVSCOM	April 1990
GLHF/LB	MICOM PMO	September 1990
AMS-H	MICOM RMD	October 1990
AAWS-M	MICOM PMO	September 1990
NL[illegible]-AD	USAADASCH	February 1991

d. Cost data presented in the TAFCS is listed in FY90 constant dollars. Personnel and equipment cost data extracted from TAFCS and other sources were then converted to FY92 constant dollars.

e. Spreadsheets were used to develop force costs for the base case and four alternatives. URS lists received from TRAC-OAC were combined with data from TAFCS and the above sources to develop these costs.

f. Force costs fall into two categories. They are nonrecurring and recurring costs. Nonrecurring costs are those "one-time" costs of the acquisition of equipment and resources. That is, those pieces of equipment and supplies required to deploy a mission capable force. Examples of nonrecurring costs are:

-- Unit costs of major and nonmajor items of equipment.
-- Ammunition items/special weapons/basic loads.
-- Prescribed load list (PLL) Authorized stockage list (ASL).
-- Other major end items.

Recurring costs are the costs of operating, training, and maintaining the force. These costs are expressed as annual costs, and may be extended over a specified period of times. For the AGMC evaluation, the recurring costs are extended over 20 years. Examples of recurring costs are:

-- OPTEMPO operating cost of equipment.
-- Personnel and non-OPTEMPO costs.
-- Training ammunition
-- Depot overhaul.

g. Costs for the base case and the four alternatives were developed on individual spreadsheets (see appendix F, annex I). There is one spreadsheet giving quantities for each unit (see table F-I-1). Nonrecurring costs and recurring costs are shown in tables F-I-2 through 26. Nonrecurring and recurring costs for the CSS units from the logistics impact analysis were developed from TAFCS and added to the base case and alternatives and are shown in tables F-I-27 through F-I-31).

h. Total force costs were developed from the spreadsheets for all study forces. Two conversions had to be made before totaling up the costs. These conversions involved nonrecurring costs, recurring costs, and FY dollars.

i. The URS level equipment lists contain only essential mission and mission support equipment. These lists do not include additional items such as ammunition initial issue, PLL and ASL, classes 1, 2, 3 basic loads and replenishment spares, and repair parts. These additional items are required to make the unit a mission-ready force. Examination of the ACR type units in TAFCS shows that the essential mission and mission support equipment represent about 80 percent of the total materiel costs with the additional items described

above accounting for the remaining 20 percent. Therefore, an additional 20 percent was added to the total costs of the URS level equipment lists to ensure a complete estimate of nonrecurring costs.

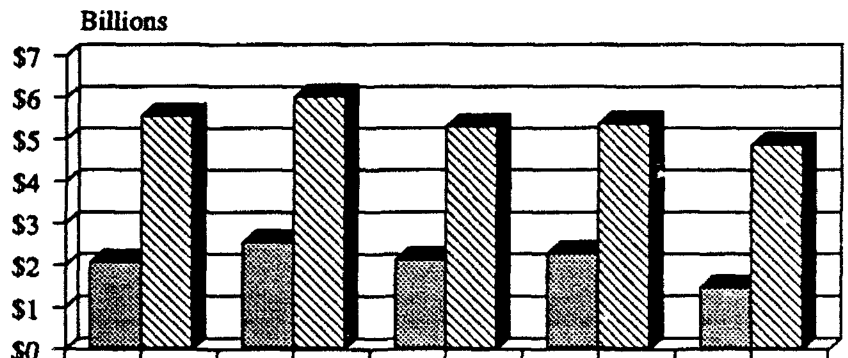
j. Recurring costs which are represented by OPTEMPO and MPA costs were developed for one year. Since these forces will be in existence for 20 years, recurring costs for 20 years were computed.

k. Finally, costs presented in the TAFCS are in FY90 constant dollars. The costs extracted from BCEs/LCCEs were presented in FY90 dollars. Force costs were converted to FY92 dollars for final presentation.

F-6. Sensitivity analysis.

a. With personnel included there is less than a 10 percent spread between the adjacent ranked study forces. The total spread from low to high is 24 percent. Personnel requirements are the primary factor for the lack of differentiation. The total costs are different in magnitude with personnel included, the rankings of the units (low to high) change to MIB, LCR, AIRCR, ACR, and MACR.

b. There is a clearer view of the rankings when personnel are excluded especially between the first and second place units as presented in figure F-2. There is a 41 percent increase between the MIB and the ACR and a 45 percent difference between the MIB and LCR (see table F-4).



	ACR	MACR	LCR	AIRCR	MIB
W/o personnel	$2.064	$2.541	$2.12	$2.277	$1.465
With personnel	$5.547	$6.012	$5.294	$5.356	$4.865

W/o personnel   With personnel

FY 92 $

Figure F-2. Total force cost comparisons, decision costs, and decision costs plus personnel

F-7. Summary of findings.

a. The base case and alternatives rankings are presented in table F-4 using the decision costs only (personnel excluded). The MIB Force Structure costs less than the other study forces, followed, in order as shown.

Table F-4. Force structure rankings

Rankings	FY92 (Millions) Decision Cost	Percent increase above MIB
MIB	$1,465	--
ACR	2,064	41%
LCR	2,120	45%
AIRCR	2,277	55%
MACR	2,541	73%

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APPENDIX F

ANNEX I

FORCE COSTING

by

Troy Young
TRADOC Analysis Command
White Sands Missile Range, NM

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APPENDIX F

ANNEX I

FORCE COSTING

Table F-I-1. Quantities

Major item of equipment	LIN	BC	MACR	LCR	AIRCR	MIB
Tank combat 120mm M1A1	T13168	123				
Tank combat 120mm BLK III			123			
Armored gun system (AGS)				118		27
Future scout vehicle (S)				90		26
APC M113A3 (RISE)	C18234	101	101			
APC M113A2	D12087	4	4			
Carrier cmd post M577A2 lt	D11538	55				
CFV HS M3A2 Bradley	F60530	116				
Future scout vehicle (C) w/AMS-H			116	100		53
AAWS-M						36
AMS-H						24
FF radar AN/TPQ36	Z52237					1
MMS AN/TMQ-31	M04941					1
M106A2 107mm mortar (less mort)	D10741	18				
Mortar 4.2 in on mnt	M68282	18				
Carrier 120mm mortar (less mort)			18	24		17
Mortar 120mm on mnt			18	24		17
81mm mortar	M02114				14	18
Rifle recoiless 90mm M67	R96484	6	6			
Carrier cgo FT M10115A1	C10858	2	2	6	6	6
Carrier cgo FT 6T M548A1	D11049	25	25			
How med SP M109A3 155mm	K57667	24				
How med SP 155mm AFAS			24			
How towed M198 155mm	K57821			16		
How towed light 155mm					16	24
Carrier pers FT M981 AFS	C12155	18	18			
Recovery veh med M88A1	R50681	14	14			
Recovery veh lt M578	R50544	2	2			
Bridge, scissor, ALVC-60	C20414	15	15			
LAB (lt assualt bridge 60 FT)	Z11216			6	6	3
Launch M60 ser tk chassis transp	L43664	15	15	6	6	3
Combat eng veh FT M728	E56578	3	3			
Amd cmbt trct HS M9 (ACE)	W76473	12	12	6	16	9
Lchr mine clrg line CHG (MICLIC)	L67342	6	6	6	6	6
Volcano dispenser mine M139	D30897			2	2	2
Loader scoop dsl 2 1/2 CUYD	L76556	1	1			
Trct dsl w/exv & fnt ldr (SEE)	Z90445	5	5	6	2	9
SMCD (Blade scraper mine clr dev)	B71632				6	
OH-58C	H31110	25				
AH-1F	H44644	10				
AH-1S	K29694	12				
LH/LB	Z33524		53	53	74	25
EH-60A	H30616	3	3	3	3	3
UH-60A	K32293	18	18	19	54	34
Hellfire/LB mtd on HMMWV					136	
AGPU (pwr aux ACFT GE 3X)	P44377				12	
AFARE	H94893			6	12	4

Major item of equipment	LIN	BC	MACR	LCR	AIRCR	MIB
UAV-C (air veh TADARS)	Z62820			20	20	20
GBCS (Ser=HMMWV+$1M eq tlr)	Z32417			6	6	6
CGS				1	1	1
Elec shop AN/ASM-146C shelter	H01907			2	2	2
Elec shop AN/ASM-147B shelter	H01912			3	3	3
M157 smoke generator	G51840			8	8	8
M17 sanators	D82404			6	6	6
NBCRS mtd on HMMWV				6	6	6
65 GPM pump	P91756			8	8	8
XM1015 (lt) [M1015A1 cgo FT)	C10858			6	6	6
Lchr grenade auto MK19 MIII 40mm	M92362	40				
Lchr grenade SS rifle 40mm M203	L44595	268	268		36	120
MG cal .50 hvy fxd turret type	L91701	123				
MG cal .50 HB flex gnd & veh	L91975	213				
MG cal .50 hvy veh fixed	L92112	3				
MG 7.62mm fixed	L92352	87				
MG 7.62 light flexible	L92386	52				
MG 7.62 fixed RH feed	M92420	2				
Rifle snipers 7.62 M24	R95387				12	12
MG lt 5.56 M249	M09009				48	156
Trk util 1/4T w/rops	X60833	3				
Trk util 3/4T M1009	T05028	13				
Trk util M1037 w/S250 shltr	T07543	23	23	18	18	18
HMMWV M998 cgo/trp car	T61494	231	231	431	384	540
HMMWV M1038 cgo/trp car	T61562	12	12			
Trk ambulance 4 ltr (HMMWV)	T38844	6	6	6	12	13
Trk cgo 5/4T M880	X39432	1	1			
Trk cgo 5/4T M885 w/comm shltr	X39441	2	2			
Trk cgo 5/4T M882 w/60amp comm kt	X39447	1	1			
Trk cgo 5/4T M1008A1 w/commo kit	T59346	39	39			
Trk cgo 5/4T M1008	T59482	13	13			
Trk cgo 5/4T M1028 shltr carr	T59414	1	1			
Trk cgo 5/4T XM1028A1 shltr carr	Z93546	4	4			
Trk cgo 2 1/2T	X40009	175	175	150	103	152
Trk cgo 2 1/2T M35A2	X40146	30	30			
Trk van 2 1/2T M109A3 w/w	X62477	15	15	6	6	6
Trk van 2 1/2T M109A3	X62340	5	5			
Trk cgo DS 2 1/2T M35A2	X40077	13	13			
Trk cgo 2 1/2T M36A2 XLWB	X40283	1	1			
Trk cgo 5T M923A2	X40794	67	67	16		
Trk cgo 5T M924A1	X40831	5	5	124	122	156
Trk cgo 5T LWB w/w	X40968	4	4			
Trk cgo 5T M927A2 XLWB	X41105	1	1			
Trk cgo 5T DS M925A2 w/w	X40931	10	10	8	14	16
Trk 5T exp van	X62237	10	10		2	
Trk tractor 5T M932A2	X59326	57	57	9	9	9
Trk tractor 5T M932A2 w/w	X59463	1	1	45	53	37
Trk tractor HET M911	T61035	6	6	6	6	6
Trk dump 5T M929A2	X43708	3	3	6		
Trk dump 5T M930A2	X43845	3	3			
Wrecker, 5T M936A2	X63299	8	8	16	6	14

Major item of equipment	LIN	BC	MACR	LCR	AIRCR	MIB
Trk wrecker M984A1 HEMMT	T63093	11	11	9	3	2
Trk TK FS 2500 gal M978 8x8 HEMMT	T87243	47	47			
Trk FS 2.5KGL M978 8x8 HEMMT	T58161	15	15	8	21	7
Trk PLS w/trailer	Z40498			4	4	4
Trk HI MOB contact	Z77299			7	7	7
Trk cargo 8x8 hvy exp mob	T39518	11	11			
Trk cgo 8x8 TAC w/md crane	T39586	5	5			
Trk cgo 8x8 TAC w/lt crane	T59278	72	72	6	12	6
RT forklift DSL 10000lb cap	T49119	1	1			
RT forklift DSL 6000lb cap	X48914	7	7	9	12	9
RT forklift DSL 4000lb cap	T49255	7	7	2	2	2
Hand truck platform	X47270	6	6			
TPU (TK-pump-unit 13217E7130)	V12141			7	3	9
Tank liq dispenser, trk mtd	V19950			6	10	6
500 gal blvts (tank FAB 66 x 36)	V14744			12	24	12
Trailer cgo 1/4T M416A1	W95400	3	3			
Trailer 3/4T M101A2	W95537	58	58	207	186	202
Trailer cgo 1 1/2T	W95811	178	178	145	74	143
Trailer ammo 1 1/2T M332	W94030	24	24		12	33
Trailer ammo 2 1/2T (Tlr Util)	W94441			6	7	5
Trailer chassis, gen 2 1/1T	E02807	8	8			
Water tlr M149A2	W98825	44	44	41	17	41
Kit field mtd on trailer M103A3	L28351	21	21	19	6	19
Trailer BOL G/P 4T M796A1	W94536	5	5			
Trailer FB 11T HEMAT M989	T45465	18	18	10	14	7
Semitrailer 12T (LB wkr M270A1)	S70243			1	2	1
Semitrailer LB 25T	S70517	1	1			
Semitrailer LB HET 60T	S70661	6	6	6	6	6
Semitrailer FB 22.5T	S70027	24	24	33	40	33
Semitrailer tank 5000 gal	S73372	22	22			
Semitrailer van 6T RPR PTS	S74832	6	6			
Semitrailer van supply 12T	S75175	6	6			
Gen DSL 15kw 60hz on M200A1	J35492	6	6	2	2	2
Gen DSL 30kw 60hz on M200A1	J36383	2	2	11	19	6
Gen DSL 60kw 60hz on M200A1	J35629	3	3	9	17	4
Gen DSL 15kw 60hz SKD TAC util	J35835	2	2			
Gen DSL 30kw 60/50 hz	J36109	4	4			
Crane tk cat RT41AA	F43003			1	2	1
Maint shops (S/E A/R FM SUP #1)	T25619			17	34	17
Welding shop tlr mtd	W48391	3	3	1	1	1
Shop EQ contact maint trk mtd	T10138	6	6			
Shop EQ elec rep Semitrailer mtd	T10275	1	1			
Elec shop stlr mtd AN/ASM189 L/P	H01855	6	6	4	4	4
Tool set tk veh org 2	W65747	3	3			
Trailer acft maint ambl	W93995	2	2			
Gun ADA 20mm SP	J96694	9	9			
Interrogator set An/PPX-3 (stinger)	J98501	22	22			
Hvy rpr veh (armored maint veh)	Z06157			6	6	6
Avenger (PMS) (FU FAADS LOS-R/PMS)	Z77248			18	18	18
Sensors				2	2	2
NLOS-AD				6	6	6

Table F-I-2. ACR nonrecurring costs

Major item of equipment	LIN	Unit cost	Qty	Total costs
Tank combat 120mm M1A1	T13168	$1,888,545	123	232,291,035
APC M113A3 (RISE)	C18234	236,050	101	23,841,050
APC M113A2	D12087	160,002	4	640,008
Carrier cmd post M577A2 lt	D11538	184,442	55	10,144,310
CFV HS M3A2 Bradley	F60530	1,144,000	116	132,704,000
M106A2 107mm mort (less mort)	D10741	205,400	18	3,697,200
Mortar 4.2 in on mnt	M68282	19,084	18	343,512
Rifle recoiless 90mm M67	R96484	9,212	6	55,272
Carrier cgo FT M10115A1	C10858	174,666	2	349,332
Carrier cgo FT 6T M548A1	D11049	220,568	25	5,514,200
How med SP M109A3 155mm	K57667	758,038	24	18,192,912
Carrier pers FT M981 AFS	C12155	477,815	18	8,600,670
Recovery veh med M88A1	R50681	836,512	14	11,711,168
Recovery veh lt M578	R50544	263,660	2	527,320
Bridge, scissor, ALVC-60	C20414	87,742	15	1,316,130
Launch M60 ser tk chassis transp	L43664	527,126	15	7,906,890
Combat eng veh FT M728	E56578	676,796	3	2,030,388
Amd cmbt trct HS M9 (ACE)	W76473	750,817	12	9,009,804
Lchr mine clear.line CHG (MICLIC)	L67342	7,000	6	42,000
Loader scoop dsl 2 1/2 CUYD	L76556	161,293	1	161,293
Trct dsl w/exv & fnt ldr (SEE)	Z90445	74,884	5	374,420
OH-58C	H31110	190,817	25	4,770,425
AH-1F	H44644	3,697,532	10	36,975,320
AH-1S	K29694	3,442,062	12	41,304,744
EH-60A	H30616	5,544,861	3	16,634,583
UH-60A	K32293	4,600,000	18	82,800,000
Lchr grenade auto MK19 MIII 40mm	M92362	21,804	40	872,160
Lchr grenade SS rifle 40mm M203	L44595	565	268	151,420
MG cal .50 hvy fxd turret type	L91701	6,905	123	849,315
MG cal .50 HB flex gnd & veh	L91975	9,714	213	2,069,082
MG cal .50 hvy veh fixed	L92112	26,071	3	78,213
MG 7.62mm fixed	L92352	4,650	87	404,550
MG 7.62 light flexible	L92386	4,383	52	227,916
MG 7.62 fixed RH feed	M92420	4,650	2	9,300
Trk util 1/4T w/rops	X60833	22,128	3	66,384
Trk util 3/4T M1009	T05028	17,018	13	221,234
Trk util M1037 w/S250 shltr	T07543	24,308	23	559,084
HMMWV M998 cgo/trp car	T61494	25,000	231	5,775,000
HMMWV M1038 cgo/trp car	T61562	25,345	12	304,140
Trk ambulance 4 ltr (HMMWV)	T38844	44,381	6	266,286
Trk cgo 5/4T M880	X39432	7,995	1	7,995
Trk cgo 5/4T M885 w/comm shltr	X39441	7,305	2	14,610
Trk cgo 5/4T M882 w/60amp com kit	X39447	8,562	1	8,562
Trk cgo 5/4T M1008A1 w/commo kit	T59346	15,460	39	602,940
Trk cgo 5/4T M1008	T59482	11,567	13	150,371
Trk cgo 5/4T M1028 shltr carr	T59414	14,141	1	14,141

Major item of equipment	LIN	Unit cost	Qty	Total costs
Trk cgo 5/4T XM1028A1 shltr carr	Z93546	16,906	4	67,624
Trk cgo 2 1/2T	X40009	41,822	175	7,318,850
Trk cgo 2 1/2T M35A2	X40146	46,750	30	1,402,500
Trk van 2 1/2T M109A3 w/w	X62477	75,420	15	1,131,300
Trk van 2 1/2T M109A3	X62340	72,574	5	362,870
Trk cgo DS 2 1/2T M35A2	X40077	48,574	13	631,462
Trk cgo 2 1/2T M36A2 XLWB	X40283	54,582	1	54,582
Trk cgo 5T M923A2	X40794	69,090	67	4,629,030
Trk cgo 5T M924A1	X40831	43,737	5	218,685
Trk cgo 5T LWB w/w	X40968	41,701	4	166,804
Trk cgo 5T M927A2 XLWB	X41105	71,610	1	71,610
Trk cgo 5T DS M925A2 w/w	X40931	73,275	10	732,750
Trk 5T exp van	X62237	122,852	10	1,228,520
Trk tractor 5T M932A2	X59326	68,724	57	3,917,268
Trk tractor 5T M932A2 w/w	X59463	72,640	1	72,640
Trk tractor HET M911	T61035	117,271	6	703,626
Trk dump 5T M929A2	X43708	74,957	3	224,871
Trk dump 5T M930A2	X43845	79,100	3	237,300
Wrecker, 5T M936A2	X63299	135,775	8	1,086,200
Trk wrecker M984A1 HEMMT	T63093	179,715	11	1,976,865
Trk TK FS 2500gl M978 8x8 HEMMT	T87243	155,083	47	7,288,901
Trk FS 2.5KGL M978 8x8 HEMMT	T58161	160,228	15	2,403,420
Trk cargo 8x8 hvy exp mob	T39518	129,638	11	1,426,018
Trk cgo 8x8 TAC w/md crane	T39586	129,930	5	649,650
Trk cgo 8x8 TAC w/lt crane	T59278	124,313	72	8,950,536
RT forklift DSL 10000lb cap	T49119	69,277	1	69,277
RT forklift DSL 6000lb cap	X48914	32,550	7	227,850
RT forklift DSL 4000lb cap	T49255	23,659	7	165,613
Hand truck platform	X47270	155	6	930
Trailer cgo 1/4T M416A1	W95400	3,067	3	9,201
Trailer 3/4T M101A2	W95537	2,251	58	130,558
Trailer cgo 1 1/2T	W95811	3,944	178	702,032
Trailer ammo 1 1/2T M332	W94030	5,149	24	123,576
Trailer chassis, gen 2 1/1T	E02807	3,632	8	29,056
Water tlr M149A2	W98825	5,518	44	242,792
Kit field mtd on trl M103A3	L28351	27,086	21	568,806
Trailer BOL G/P 4T M796A1	W94536	8,957	5	44,785
Trailer FB 11T HEMAT M989	T45465	11,625	18	209,250
Semitrailer LB 25T	S70517	7,729	1	7,729
Semitrailer LB HET 60T	S70661	70,564	6	423,384
Semitrailer FB 22.5T	S70027	15,542	24	373,008
Semitrailer tank 5000 gal	S73372	50,628	22	1,113,816
Semitrailer van 6T RPR PTS	S74832	32,952	6	197,712
Semitrailer van supply 12T	S75175	27,591	6	165,546
Gen DSL 15kw 60hz on M200A1	J35492	20,039	6	120,234
Gen DSL 30kw 60hz on M200A1	J36383	20,810	2	41,620
Gen DSL 60kw 60hz on M200A1	J35629	23,731	3	71,193
Gen DSL 15kw 60hz SKD TAC util	J35835	13,551	2	27,102

Major item of equipment	LIN	Unit cost	Qty	Total costs
Gen DSL 30kw 60/50 hz	J36109	14,891	4	59,564
Welding shop tlr mtd	W48391	25,050	3	75,150
Shop EQ contact maint trk mtd	T10138	16,361	6	98,166
Shop EQ elec rep semitrl mtd	T10275	170,152	1	170,152
Elec shop tlr mtd AN/ASM189L/P	H01855	109,665	6	657,990
Tool set tk veh org 2	W65747	6,656	3	19,968
Trailer acft maint ambl	W93995	2,272	2	4,544
Gun ADA 20mm SP	J96694	861,905	9	7,757,145
Interrog set An/PPX-3(stinger)	J98501	18,115	22	398,530
Total unit prices extended - FY 90 $				725,850,850
Note: This total is 80% of the materiel acquisition cost total materiel acquisition cost (nonrecurring) FY 90				907,313,563

Table F-I-3. ACR MPA costs

Personnel	Authorized	Average MPA	MPA FY 90 $
Officer	287	$45,881	$13,167,847
Warrant officer	132	37,206	4,911,192
Enlisted	4,282	22,917	98,130,594
Total	4,701		$116,209,633
Total 20 years			$2,324,192,660

Table F-I-4. ACR OPTEMPO costs (FY 90 $)

Nomenclature	LIN	Qty	OP Temp	Spare $/UofM	Rpr Pts $/UofM	POL $/UofM	Total recurring
Tank combat 120mm M1A1	T13168	123	964	75	36	6.97	13,987,939
APC M113A3 (RISE)	C18234	101	515	1.95	3.8	0.57	328,735
APC M113A2	D12087	4	515	1.87	3.65	0.55	12,504
Carrier cmd post M577A2	D11538	55	709	1.97	5.04	0.55	294,802
CFV HS M3A2 Bradley	F60530	116	515	49	20	1.15	4,190,761
M106A2 107mm mortar	D10741	18	1232	1.68	4.8	0.55	155,897
(less mortar)	C10858	2	830	2.3	4.13	0.55	11,587
Carr cgo FT 6T M548A1	D11049	25	830	2.3	4.13	0.55	144,835
How medSP M109A3 155mm	K57667	24	1092	9.07	14.4	0.84	637,116
Carr pers FT M981 AFS	C12155	18	448	20	5.6	0.62	211,438
Recovery veh med M88A1	R50681	14	793	4.46	10.56	0.89	25,233
Recovery veh lt M578	R50544	2	762	65.26	23.99	1.88	972,175
Bridge, scissor ALVC-60	C20414	15	290	0	428.98	0	1,866,063
Launch M60 ser tk chassis transp	L43664	15	527	48.94	23.03	1.88	583,784
Combat eng veh FT M728	E56578	3	503	43.19	23.99	1.88	104,212
Amd cmbt trct HS M9 ACE	W76473	12	1029	8.35	12.57	5.93	331,544
Loader scoop dsl 2.5 CU YD	L76556	1	709	0.91	7.63	3.47	8,515
OH-58C	H31110	25	257	142	111.32	23	1,775,356
AH-1F	H44644	10	210	1689	206.33	86.37	4,994,035
AH-1S	K29694	12	210	1689	206.33	86.37	4,161,696
EH-60A	H30616	3	182	858.9	174.66	114.2	626,693
UH-60A	K32293	18	258	858.9	174.66	114.2	5,330,337
Gun ADA 20mm AR SP M163	J96694		1151	65.26	16.31	0.55	850,681
Trk util 1/4T w/rops	X60833	3	4510	0.05	0.14	0.12	4,194
Trk util M1037 w/S250 sh	T07543	23	364	0.05	0.24	0.07	3,014
HMMWV M998 cgo/trp carr	T61494	231	4486	0.05	0.24	0.07	373,056
HMMWV M1038 cgo/trp carr	T61562	12	3235	0.05	0.24	0.07	13,975
Trk amb 4 ltr (HMMWV)	T38844	6	364	0.05	0.24	0.07	786
Trk cgo 5/4T M880	X39432	1	3127	0.1	0.19	0.19	1,501
Trk cgo 5/4T M885 w/comm shltr	X39441	2	364	0.05	1.82	0.08	1,420
Trk cgo 5/4T M882 w/60 amp comm kit	X39447	1	1871	0.05	1.82	0.08	3,648
Trk cgo 5/4T M1008A1	T59346	39	2088	0.05	0.2	0.08	26,873
w/commo kit						0.08	52,931
Trk cgo 5/4T M1008	T59482	13	2088	0.05	1.82		
Trk cgo 5/4T M1028 SC	T59414	1	1030	0.05	1.82	0.08	2,009
Trk cgo 5/4T XM1028A1 XM1028A1 shltr carr	Z93546	4	364	0.05	1.82	0.08	2,839
Trk cgo 2.5T	X40009	175	3545	0.02	0.82	0.19	638,366
Trk cgo 2.5T M35A2	X40146	30	2227	0.19	0.82	0.19	80,172

Nomenclature	LIN	Qty	OP Temp	Spare $/UofM	Rpr Pts $/UofM	POL $/UofM	Total recurring
Trk van 2.5T M109A3 w/w	X62477	15	2227	0.19	0.82	0.19	40,086
Trk van 2.5T M109A3	X62340	5	224	0.19	0.82	0.19	1,344
Trk cgo DS 2.5T M35A2	X40077	13	10400	0.19	0.82	0.19	162,240
Trk cgo 2.5T M36A2 XLWB	X40283	1	2227	0.19	0.82	0.19	2,672
Trk cgo 5T M923A2	X40794	67	4203	0.2	0.29	0.18	751,875
Trk cgo 5T M924A1	X40831	5	2278	0.2	1.01	0.25	13,304
Trk cgo 5T LWB w/w	X40968	4	1790	0.2	1.05	0.2	12,978
Trk cgo 5T M927A2 XLWB	X41105	1	1790	0.2	1.01	0.25	2,613
Trk cgo 5T DS M925A2w/w	X40931	10	179	0.2	1.01	0.25	2,613
Trk 5T exp van	X62237	10	1683	0.2	1.05	0.26	25,413
Trk tractor 5T M932A2	X59326	57	8912	0.2	0.29	0.18	340,349
Trk trctr 5T M932A2 w/w	X59463	1	2400	0.2	0.29	0.18	1,608
Wrecker, 5T M936A2	X63299	8	1766	0.2	0.67	0.6	20,768
Trk wrckr M984A1 HEMMT	T63093	11	1107	0.2	0.67	0.6	17,900
CL steam HI pre WT JT	C32887		396	0	1.06	6	2,796
Dispenser mine M128	D20529		178	0	29.75	0.1	10,627
Gen SM mech pulse jet	J30492		72	0	2.11	0	1,823
Gen ST TM PU-405A/M	J35492		279	0	1.1	1.5	4,352
Gen ST Tm PU-625/G	J46252		352	0	1.1	0.6	1,197
Heater MIL H11049	K24862		246	0	0.82	0	6,253
Total OPTEMPO costs FY 90 $							44,233,533
Total OPTEMPO costs FY 90 $ - 20 years							884,670,660

Table F-I-5. ACR force costs

Type cost	FY 90 dollars	FY 92 dollars
Nonrecurring (EQUIP)	$907,313,563	$986,068,380
Recurring (20 yr OPTEMPO)	$884,670,660	$961,460,073
Total without personnel	$1,791,984,223	$1,947,528,454
20 year MPA (unit)	$2,324,192,660	$2,525,932,583
Total with personnel	$4,116,176,883	$4,473,461,036

Table F-I-6. ACR recap

FY 92 dollars

Equipment & OPTEMPO	Unit Log Decision cost	$1,947,528,454 $116,897,000 $2,064,425,454
MPA	Unit Log Total MPA	$2,525,932,583 $956,700,000 $3,482,632,583
Total		$5,547,058,036

Table F-I-7. MACR nonrecurring costs

Major item of equipment	LIN	Unit cost	Qty	Total cost
Tank combat 120mm Blk III		3,956,000	123	486,588,000
APC M113A3 (RISE)	C18234	236,050	101	23,841,050
APC M113A2	D12087	160,002	4	640,008
Carrier cmd post M577A2 lt	D11538	184,442	55	10,144,310
Future scout veh (C) w/AMS-H		1,025,736	116	118,985,376
Carrier 120mm mort (less mort)		205,400	18	3,697,200
Mortar 120mm on mount	Z20400	19,084	18	343,512
Rifle recoiless 90mm M67	R96484	9,212	6	55,272
Carrier cgo FT M10115A1	C10858	174,666	2	349,332
Carrier cgo FT 6T M548A1	D11049	220,568	25	5,514,200
How med SP 155mm AFAS		3,892,160	24	93,411,840
Carrier pers FT M981 AFS	C12155	477,815	18	8,600,670
Recovery veh med M88A1	R50681	836,512	14	11,711,168
Recovery veh lt M578	R50544	263,660	2	527,320
Bridge, scissor, ALVC-60	C20414	87,742	15	1,316,130
Launch M60 ser Tk chassis transp	L43664	527,126	15	7,906,890
Combat eng veh FT M728	E56578	676,796	3	2,030,388
Amd cmbt trct HS M9 (ACE)	W76473	750,817	12	9,009,804
Lchr mine clearline CHG(MICLIC)	L67342	7,000	6	42,000
Loader scoop dsl 2 1/2 CUYD	L76556	161,293	1	161,293
Trct dsl w/exv & fnt ldr (SEE)	Z90445	74,884	5	374,420
LH/LB		8,200,000	53	434,600,000
EH-60A	H30616	5,544,861	3	16,634,583
UH-60A	K32293	4,600,000	18	82,800,000
Lchr grenade SS rifle 40mm M203	L44595	565	268	151,420
Trk util M1037 w/S250 shltr	T07543	24,308	23	559,084
HMMWV M998 cgo/trp car	T61494	25,000	231	5,775,000
HMMWV M1038 cgo/trp car	T61562	25,345	12	304,140
Trk ambulance 4 ltr (HMMWV)	T38844	44,381	6	266,286
Trk cgo 5/4T M880	X39432	7,995	1	7,995
Trk cgo 5/4T M885 w/comm shltr	X39441	7,305	2	14,610
Trk cgo 5/4T M882 w/60 amp cm kit	X39447	8,562	1	8,562
Trk cgo 5/4T M1008A1 w/commo kit	T59346	15,460	39	602,940
Trk cgo 5/4T M1008	T59482	11,567	13	150,371
Trk cgo 5/4T M1028 shltr carr	T59414	14,141	1	14,141
Trk cgo 5/4T XM1028A1 shltr carr	Z93546	16,906	4	67,624
Trk cgo 2 1/2T	X40009	41,822	175	7,318,850
Trk cgo 2 1/2T M35A2	X40146	46,750	30	1,402,500
Trk van 2 1/2T M109A3 w/w	X62477	75,420	15	1,131,300
Trk van 2 1/2T M109A3	X62340	72,574	5	362,870
Trk cgo DS 2 1/2T M35A2	X40077	48,574	13	631,462
Trk cgo 2 1/2T M36A2 XLWB	X40283	54,582	1	54,582
Trk cgo 5T M923A2	X40794	69,090	67	4,629,030
Trk cgo 5T M924A1	X40831	43,737	5	218,685
Trk cgo 5T LWB w/w	X40968	41,701	4	166,804
Trk cgo 5T M927A2 XLWB	X41105	71,610	1	71,610

Major item of equipment	LIN	Unit Cost	Qty	Total Cost
Trk cgo 5T DS M925A2 w/w	X40931	73,275	10	732,750
Trk 5T exp van	X62237	122,852	10	1,228,520
Trk tractor 5T M932A2	X59326	68,724	57	3,917,268
Trk tractor 5T M932A2 w/w	X59463	72,640	1	72,640
Trk tractor HET M911	T61035	117,271	6	703,626
Trk dump 5T M929A2	X43708	74,957	3	224,871
Trk dump 5T M930A2	X43845	79,100	3	237,300
Wrecker, 5T M936A2	X63299	135,775	8	1,086,200
Trk wrecker M984A1 HEMMT	T63093	179,715	11	1,976,865
Trk TK FS 2500gl M978 8x8 HEMMT	T87243	155,083	47	7,288,901
Trk FS 2.5KGL M978 8x8 HEMMT	T58161	160,228	15	2,403,420
Trk cargo 8x8 hvy exp mob	T39518	129,638	11	1,426,018
Trk cgo 8x8 TAC w/md crane	T39586	129,930	5	649,650
Trk cgo 8x8 TAC w/lt crane	T59278	124,313	72	8,950,536
RT forklift DSL 10000lb cap	T49119	69,277	1	69,277
RT forklift DSL 6000lb cap	X48914	32,550	7	227,850
RT forklift DSL 4000lb cap	T49255	23,659	7	165,613
Hand truck platform	X47270	155	6	930
Trailer cgo 1/4T M416A1	W95400	3,067	3	9,201
Trailer 3/4T M101A2	W95537	2,251	58	130,558
Trailer cgo 1 1/2T	W95811	3,944	178	702,032
Trailer ammo 1 1/2T M332	W94030	5,149	24	123,576
Trailer chassis, gen 2 1/1T	E02807	3,632	8	29,056
Water tlr M149A2	W98825	5,518	44	242,792
Kit field mtd on trl M103A3	L28351	27,086	21	568,806
Trailer BOL G/P 4T M796A1	W94536	8,957	5	44,785
Trailer FB 11T HEMAT M989	T45465	11,625	18	209,250
Semitrailer LB 25T	S70517	7,729	1	7,729
Semitrailer LB HET 60T	S70661	70,564	6	423,384
Semitrailer FB 22.5T	S70027	15,542	24	373,008
Semitrailer tank 5000 gal	S73372	50,628	22	1,113,816
Semitrailer van 6T RPR PTS	S74832	32,952	6	197,712
Semitrailer van supply 12T	S75175	27,591	6	165,546
Gen DSL 15kw 60hz on M200A1	J35492	20,039	6	120,234
Gen DSL 30kw 60hz on M200A1	J36383	20,810	2	41,620
Gen DSL 60kw 60hz on M200A1	J35629	23,731	3	71,193
Gen DSL 15kw 60hz SKD TAC util	J35835	13,551	2	27,102
Gen DSL 30kw 60/50 hz	J36109	14,891	4	59,564
Welding shop tlr mtd	W48391	25,050	3	75,150
Shop EQ contact maint trk mtd	T10138	16,361	6	98,166
Shop EQ elec rep semitrl mtd	T10275	170,152	1	170,152
Elec shop trl mtd AN/ASM189 L/P	H01855	109,665	6	657,990
Tool set tk veh org 2	W65747	6,656	3	19,968
Trailer acft maint ambl	W93995	2,272	2	4,544
Gun ADA 20mm SP	J96694	861,905	9	7,757,145
Interrog set An/PPX-3 (stinger)	J98501	18,115	22	398,530
Total equipment costs extended - FY 90 $ (80%)				1,388,399,476
Total materiel acquisition costs FY 90 $ (100%)				1,735,499,345

Table F-I-8. MACR MPA costs

Personnel	Authorized	Average MPA	MPA FY 90 $
Officer	287	$45,881	$13,167,847
Warrant officer	166	37,206	6,176,196
Enlisted	4203	22,917	96,320,151
Total	4656		$115,664,194
Total 20 years			$2,313,283,880

Table F-I-9. MACR OPTEMPO costs FY 90 $

Nomenclature	LIN	Qty	OP Temp	Spare $/UofM	Rpr Pts $/UofM	POL $/UofM	Total recurring
Tank cbt 120mm Blk III		123					$3,788,041
APC M113A3 (RISE)	C18234	101	515	1.95	3.8	0.57	328,735
APC M113A2	D12087	4	515	1.87	3.65	0.55	12,504
Carr cmd post M577A2Lt	D11538	55	709	1.97	5.04	0.55	294,802
Fut sct veh(C) w/AMS-H	F60530	116					3,107,988
M106A2 107 mortar (less mortar)	D10741	18	1232	1.68	4.8	0.55	155,897
Carr cgo FT M10115A1	C10858	2	830	2.3	4.13	0.55	11,587
Carr cgo FT 6T M548A1	D11049	25	830	2.3	4.13	0.55	144,835
How med SP 155mm AFAS	K57667	24					905,410
Carr pers FT M981 AFS	C12155	18	448	20	5.6	0.62	211,438
Recovery veh med M88A1	R50681	14	793	4.46	10.56	0.89	25,233
Recovery veh lt M578	R50544	2	762	65.26	23.99	1.88	972,175
Bridge, scis, ALVC-60	C20414	15	290	0	428.98	0	1,866,063
Launch M60 ser tk chassis transp	L43664	15	527	48.94	23.03	1.88	583,784
Combat eng veh FT M728	E56578	3	503	43.19	23.99	1.88	104,212
Amd combat trct HS M9 ACE	W76473	12	1029	8.35	12.57	5.93	331,544
Load scoop dsl 2.5CUYD	L76556	1	709	0.91	7.63	3.47	8,515
LH		53					2,478,971
EH-60A	H30616	3	182	858.93	174.66	114.2	626,693
UH-60A	K32293	18	258	858.93	174.66	114.2	5,330,337
Gun ADA 20mm AR SP M163	J96694		1151	65.26	16.31	0.55	850,681
Trk util 1/4T w/rops	X60833	3	4510	0.05	0.14	0.12	4,194
Trk util M1037 w/S250	T07543	23	364	0.05	0.24	0.07	3,014
HMMWV M998 cgo/trp car	T61494	231	4486	0.05	0.24	0.07	373,056
HMMWV M1038 cgo/trp car	T61562	12	3235	0.05	0.24	0.07	13,975
Trk amb 4 ltr (HMMWV)	T38844	6	364	0.05	0.24	0.07	786

Nomenclature	LIN	Qty	OP Temp	Spare $/UofM	Rpr Pts $/UofM	POL $/UofM	Total recurring
Trk cgo 5/4T M880	X39432	1	3127	0.1	0.19	0.19	1,501
Trk cgo 5/4T M885 w/comm shltr	X39441	2	364	0.05	1.82	0.08	1,420
Trk cgo 5/4T M882 w/60 amp comm kit	X39447	1	1871	0.05	1.82	0.08	3,648
Trk cgo 5/4T M1008A1 w/commo kit	T59346	39	2088	0.05	0.2	0.08	26,873
Trk cgo 5/4T M1008	T59482	13	2088	0.05	1.82	0.08	52,931
Trk cgo 5/4T M1028 SC	T59414	1	1030	0.05	1.82	0.08	2,009
Trk cgo 5/4T XM1028A1 shltr carrier	Z93546	4	364	0.05	1.82	0.08	2,839
Trk cgo 2.5T	X40009	175	3545	0.02	0.82	0.19	638,366
Trk cgo 2.5T M35A2	X40146	30	2227	0.19	0.82	0.19	80,172
Trk van 2.5 M109A3w/w	X62477	15	2227	0.19	0.82	0.19	40,086
Trk van 2.5T M109A3	X62340	5	224	0.19	0.82	0.19	1,344
Trk cgo DS 2.5T M35A2	X40077	13	10400	0.19	0.82	0.19	162,240
Trk cgo 2.5T M36A2 XLWB	X40283	1	2227	0.19	0.82	0.19	2,672
Trk cgo 5T M923A2	X40794	67	4203	0.2	0.29	0.18	751,875
Trk cgo 5T M924A1	X40831	5	2278	0.2	1.01	0.25	13,304
Trk cgo 5T LWB w/w	X40968	4	1790	0.2	1.05	0.2	12,978
Trk cgo 5T M927A2 XLWB	X41105	1	1790	0.2	1.01	0.25	2,613
Trk cgo 5T DS M925A2w/w	X40931	10	179	0.2	1.01	0.25	2,613
Trk 5T exp van	X62237	10	1683	0.2	1.05	0.26	25,413
Trk tractor 5T M932A2	X59326	57	8912	0.2	0.29	0.18	340,349
Trk trct 5T M932A2 w/w	X59463	1	2400	0.2	0.29	0.18	1,608
Wrecker, 5T M936A2	X63299	8	1766	0.2	0.67	0.6	20,768
Trk wrckr M984A1 HEMMT	T63093	11	1107	0.2	0.67	0.6	17,900
CL steam HI pre WT JT	C32887		396	0	1.06	6	2,796
Dispenser mine M128	D20529		178	0	29.75	0.1	10,627
Gen SM mech pulse jet	J30492		72	0	2.11	0	1,823
Gen ST TM PU-405A/M	J35492		279	0	1.1	1.5	4,352
Gen ST TM PU-625/G	J46252		352	0	1.1	0.6	1,197
Heater MIL H11049	K24862		246	0	0.82	0	6,253
Total OPTEMPO costs FY 90 $							24,767,040
Total OPTEMPO costs FY 90 $ - 20 years							495,340,800

Table F-I-10. MACR force costs

Type cost	FY 90 dollars	FY 92 dollars
Nonrecurring (EQUIP) Recurring (20 yr OPTEMPO)	$1,735,499,345 $495,340,800	$1,886,140,688 $538,336,381
Total without personnel	$2,230,840,145	$2,424,477,069
20 year MPA	$2,313,283,880	$2,514,076,921
Total with personnel	$4,544,124,025	$4,938,553,990

Table F-I-11. MACR recap FY 92 dollars

Equipment & OPTEMPO	Unit Log Decision cost	$2,424,477,069 $116,897,000 $2,541,374,069
MPA	Unit Log Total MPA	$2,514,076,921 $956,700,000 $3,470,776,921
Total		$6,012,150,990

Table F-I-12. LCR nonrecurring costs

Major item of equipment	LIN	Unit cost	Qty	Total cost
Armored gun system		$2,600,000	118	$306,800,000
Future scout vehicle (S)		651,000	90	58,590,000
Future scout vehicle (C) w/AMS-H		1,025,736	100	102,573,600
Carrier 120mm mort(less mort) SP		205,400	24	4,929,600
Mortar 120mm on mount	Z20400	19,084	24	458,016
How towed M198 155mm	K57821	309,169	16	4,946,704
LAB (lt assault brdg 60 ft)	Z11216	59,419	6	356,514
Launch M60 ser tk chassis transp	L43664	527,126	6	3,162,756
Amd cmbt trct HS M9 (ACE)	W76473	750,817	6	4,504,902
Lchr mine clr line CHG (MICLIC)	L67342	7,000	6	42,000
Volcano dispenser mine M139	D30897	60,000	2	120,000
Trct dsl w/exv & fnt ldr (SEE)	Z90445	74,884	6	449,304
LH/LB		8,200,000	53	434,600,000
EH-60A	H30616	5,544,861	3	16,634,583
UH-60A	K32293	4,600,000	19	87,400,000
AFARE	H94893	8,899	6	53,394
UAV-C (air veh TADARS)	Z62820	2,442,308	20	48,846,160
GBCS (ser=HMMWV+$1M equip tlr)	Z32417	1,025,000	6	6,150,000
CGS		N/A	1	0
Elec shop AN/ASM-146C shelter	H01907	45,349	2	90,698
Elec shop AN/ASM-147B shelter	H01912	41,244	3	123,732
M157 smoke generator	G51840	18,524	8	148,192
M17 sanators	D82404	17,888	6	107,328
NBCRS mtd on HMMWV		N/A	6	0
65 GPM pump	P91756	1,377	8	11,016
XM1015 (lt) [M1015A1 cgo ft]	C10858	174,666	6	1,047,996
Trk util M1037 w/S250 shltr	T07543	24,308	18	437,544
HMMWV M998 cgo/trp car	T61494	25,000	431	10,775,000
Trk ambulance 4 ltr (HMMWV)	T38844	44,381	6	266,286
Trk cgo 2 1/2T	X40009	41,822	150	6,273,300
Trk van 2 1/2T M109A3 w/w	X62477	75,420	6	452,520
Trk cgo 5T M923A2	X40794	69,090	16	1,105,440
Trk cgo 5T M924A1	X40831	43,737	124	5,423,388
Trk tractor 5T M932A2	X59326	68,724	9	618,516
Trk tractor 5T M932A2 w/w	X59463	72,640	45	3,268,800
Trk tractor HET M911	T61035	117,271	6	703,626
Trk PLS w/tlr	Z40498	158,468	4	633,872
Trk HI MOB contact	Z77299	33,663	7	235,641
Wrecker, 5T M936A2	X63299	135,775	16	2,172,400
Trk wrecker M984A1 HEMMT	T63093	179,715	9	1,617,435
Trk cgo 5T DS M925A2 w/w	X40931	73,275	8	586,200
Trk FS 2.5KGL M978 8x8 HEMMT	T58161	160,228	8	1,281,824
Trk dump 5T M929A2	X43708	74,957	6	449,742
Trk cgo 8x8 TAC w/lt crane	T59278	124,313	6	745,878
RT forklift DSL 6000lb cap	X48914	32,550	9	292,950
RT forklift DSL 4000lb cap	T49255	23,659	2	47,318
TPU (tk-pump-unit 13217E7130)	V12141	7,152	7	50,064

Major item of equipment	LIN	Unit costT	Qty	Total cost
Tank liq dispenser, trk mtd	V19950	1,825	6	10,950
Trailer 3/4T M101A2	W95537	2,251	207	465,957
Trailer cgo 1 1/2T	W95811	3,944	145	571,880
500 gal blivets (tanks FAB(66x36)	V14744	1,097	12	13,164
Tlr ammo 2 1/2T (tlr util)	W94441	1,186	6	7,116
Water tlr M149A2	W98825	5,518	41	226,238
Kit field mtd on trailer M103A3	L28351	27,086	19	514,634
Trailer FB 11T HEMAT M989	T45465	11,625	18	209,250
Semitrailer 12T (LB wkr M270A1)	S70243	18,673	1	18,673
Semitrailer LB HET 60T	S70661	70,564	6	423,384
Semitrailer FB 22.5T	S70027	15,542	24	373,008
Gen DSL 15kw 60hz on M200A1	J35492	20,039	6	120,234
Gen DSL 30kw 60hz on M200A1	J36383	20,810	2	41,620
Gen DSL 60kw 60hz on M200A1	J35629	23,731	3	71,193
Welding shop tlr mtd	W48391	25,050	1	25,050
Crane tk CAT RT41AA	F43003	57,887	1	57,887
Maint shops (S/E A/R FM sup #1)	T25619	20,874	17	354,858
Elec shop stlr mtd AN/ASM189 L/P	H01855	109,665	4	438,660
Hvy rpr veh (armored maint veh)	Z06157	498,538	6	2,991,228
Avenger (FU FAADS LOS-R/PMS)	Z77248	1,106,715	18	19,920,870
Sensors		N/A	2	0
NLOS-AD		741,000	6	4,446,000
Total equipment costs extended - FY 90 $ (80%)				1,150,886,093
Total materiel acquisition cost FY 90 $ (100%)				1,438,607,616

Table F-I-13. LCR MPA costs

Personnel	Authorized	Average MPA	MPA FY 90 $
Officer	298	$45,881	$13,672,538
Warrant	175	37,206	$6,511,050
Enlisted	4024	22,917	$92,218,008
Total	4497		$112,401,596
Total 20 years			$2,248,031,920

Table F-I-14. LCR OPTEMPO costs FY 90 $

Nomenclature	LIN	Qty	OP Temp	Spare $/UofM	Rpr Pts $/UofM	POL $/UofM	Total recurring
Armored gun system		118					$3,037,438
Future scout veh (S)		90					1,841,670
Fut scout veh(C) w/AMS-H		100					2,679,300
120mm mortar carrier		24	1232	1.68	4.8	0.55	207,863
Carrier cgo ft M1015A1	C10858	6	830	2.3	4.13	0.55	34,760
Hw md tw M198 155mm	K57821	16	1092	9.07	14.4	0	410,068
NLOS-AD		6					138,978
LAB (lt aslt brdg 60 ft)	Z11216	6	290	0	428.98	0	746,425
Launch M60 ser tk chas	L43664	6	527	48.94	23.03	1.88	233,514
Amd cmb trc HS M9 (ACE)	W76473	6	1029	8.35	12.57	5.93	165,772
Trac dsl w/excv&fl (SEE)	Z90445	6	709	0.91	7.63	3.47	51,091
LH/LB	Z33524	53					2,478,971
EH-60A	H30616	3	182	858.93	174.66	114.2	626,693
UH-60A	K32293	18	258	858.93	174.66	114.2	5,330,337
Avenger	Z27724	18	1151	65.26	16.31	0.55	1,701,362
Trk utl M1037 w/S250 shl	T07543	23	364	0.05	0.24	0.07	3,014
HMMWV M998 cgo/trp car	T61494	435	4486	0.05	0.24	0.07	702,508
Trk amb 4 ltr (HMMWV)	T38844	6	364	0.05	0.24	0.07	786
Trk cgo 2 1/2T	X40009	150	3545	0.02	0.82	0.19	547,171
Trk van 2 1/2T M109A3	X62340	6	224	0.19	0.82	0.19	1,613
Trk cgo 5T M924A1	X40794	16	4203	0.2	0.29	0.18	45,056
Trk 5T M924A1	X40831	124	1790	0.2	1.05	0.2	321,847
Trk tractor 5T M932A2	X59326	54	8912	0.2	0.29	0.18	322,436
Wrecker, 5T M936A2	X63299	16	1766	0.2	0.67	0.6	41,536
Trk wrkr M984A1 HEMMT	T63093	9	1107	0.2	0.67	0.6	14,646
CL steam HI pre WT JT	C32887	1	396	0	1.06	6	2,796
Dispenser mine M128	D20529	2	178	0	29.75	0.1	10,627
Gen SM mech pulse jet	J30492	8	72	0	2.11	0	1,215
Gen ST TM PU-405A/M	J35492	9	279	0	1.1	1.5	6,529
Gen ST TM PU-625/G	J46252	2	352	0	1.1	0.6	1,197
Heater MIL H11049	K24862	31	246	0	0.82	0	6,253
Total OPTEMPO costs FY 90 $							21,713,472
Total OPTEMPO costs FY 90 $ - 20 years							434,269,440

Table F-I-15. LCR force costs

Type cost	FY 90 dollars	FY 92 dollars
Nonrecurring	$1,438,607,616	$1,563,478,757
Recurring (20 yr OPTEMPO)	$434,269,440	$471,964,027
Total without personnel	$1,872,877,056	$2,035,442,784
20 year MPA	$2,248,031,920	$2,443,161,091
Total with personnel	$4,120,908,976	$4,478,603,875

Table F-I-16. LCR recap

Equipment & OPTEMPO	Unit	$2,035,442,784
	Log	$84,626,000
	Decision cost	$2,120,068,784
MPA	Unit	$2,443,161,091
	Log	$731,240,000
	Total MPA	$3,174,401,091
Total		$5,294,469,875

Table F-I-17. AIRCR nonrecurring costs

Major item of equipment	LIN	Unit cost	Qty	Total cost
How towed light 155mm		$950,000	16	15,200,000
81mm mortar	M02114	23,000	8	184,000
Rifle snipers 7.62 M24	R95387	5,145	12	61,740
MG lt 5.56 M249	M09009	1,570	48	75,360
LAB (lt assault brdg 60 ft)	Z11216	59,419	6	356,514
Launch M60 ser Tk chassis transp	L43664	527,126	6	3,162,756
Amd cmbt trct HS M9 (ACE)	W76473	750,817	16	12,013,072
Lchr mine clear line CHG (MICLIC)	L67342	7,000	6	42,000
Volcano dispenser mine M139	D30897	60,000	2	120,000
SMCD (blade scraper mine clr dev)	B71632	79,000	6	474,000
Trct dsl w/exv & fnt ldr (SEE)	Z90445	74,884	2	149,768
LH/LB		8,200,000	74	606,800,000
EH-60A	H30616	5,544,861	3	16,634,583
UH-60A	K32293	4,600,000	54	248,400,000
Hellfire/LB mtd on HMMWV		1,152,480	136	156,737,280
AGPU (pwr aux ACFT GE 3K)	P44377	859	12	10,308
AFARE	H94893	8,899	12	106,788
UAV-C (air veh TADARS)	Z62820	2,442,308	20	48,846,160
GBCS (ser=HMMWV+$1M equip tlr)	Z32417	1,025,000	6	6,150,000
CGS		N/A	1	0
Elec shop AN/ASM-146C shelter	H01907	45,349	2	90,698
Elec shop AN/ASM-147B shelter	H01912	41,244	3	123,732
M157 smoke generator	G51840	18,524	8	148,192
M17 sanators	D82404	17,888	6	107,328
NBCRS mtd on HMMWV		N/A	6	0
65 GPM pump	P91756	1,377	8	11,016
XM1015 (lt) [M1015A1 cgo ft]	C10858	174,666	6	1,047,996
Trk util M1037 w/S250 shltr	T07543	24,308	18	437,544
HMMWV M998 cgo/trp car	T61494	25,000	328	8,200,000
Trk ambulance 4 ltr (HMMWV)	T38844	44,381	12	532,572
Trk cgo 2 1/2T	X40009	41,822	95	3,973,090
Trk van 2 1/2T M109A3 w/w	X62477	75,420	6	452,520
Trk cgo 5T M924A1	X40831	43,737	122	5,335,914
Trk tractor 5T M932A2	X59326	68,724	9	618,516
Trk tractor 5T M932A2 w/w	X59463	72,640	53	3,849,920
Trk tractor HET M911	T61035	117,271	6	703,626
Trk PLS w/tlr	Z40498	158,468	4	633,872
Trk HI MOB contact	Z77299	33,663	7	235,641
Wrecker, 5T M936A2	X63299	135,775	6	814,650
Trk wrecker M984A1 HEMMT	T63093	179,715	3	539,145
Trk cgo 5T DS M925A2 w/w	X40931	73,275	24	1,758,600
Trk FS 2.5KGL M978 8x8 HEMMT	T58161	160,228	21	3,364,788
Trk 5T exp van	X62237	122,852	2	245,704
Trk cgo 8x8 TAC w/lt crane	T59278	124,313	12	1,491,756
RT forklift DSL 6000lb cap	X48914	32,550	12	390,600
RT forklift DSL 4000lb cap	T49255	23,659	2	47,318

Major item of equipment	LIN	Unit cost	Qty	Total cost
TPU (tk-pump-unit 13217E7130)	V12141	7,152	3	21,456
Tank liq dispenser, trk mtd	V19950	1,825	10	18,250
Trailer 3/4T M101A2	W95537	2,251	180	405,180
Trailer cgo 1 1/2T	W95811	3,944	86	339,184
500 gal blivets (tanks FAB 66x36)	V14744	1,097	24	26,328
Tlr ammo 1 1/2T M332	W94030	5,149	12	61,788
Tlr ammo 2 1/2T (Tlr Util)	W94441	1,186	7	8,302
Water tlr M149A2	W98825	5,518	17	93,806
Kit field mtd on trailer M103A3	L28351	27,086	6	162,516
Trailer FB 11T HEMAT M989	T45465	11,625	14	162,750
Semitrailer 12T (LB wkr M270A1)	S70243	18,673	2	37,346
Semitrailer LB HET 60T	S70661	70,564	6	423,384
Semitrailer FB 22.5T	S70027	15,542	40	621,680
Gen DSL 15kw 60hz on M200A1	J35492	20,039	2	40,078
Gen DSL 30kw 60hz on M200A1	J36383	20,810	19	395,390
Gen DSL 60kw 60hz on M200A1	J35629	23,731	17	403,427
Welding shop tlr mtd	W48391	25,050	1	25,050
Crane tk CAT RT41AA	F43003	57,887	2	115,774
Maint shops (S/E A/R FM sup #1)	T25619	20,874	34	709,716
Elec shop stlr mtd AN/ASM189 L/P	H01855	109,665	4	438,660
Hvy rpr veh (armored maint veh)	Z06157	498,538	6	2,991,228
Avenger (FU FAADS LOS-R/PMS)	Z77248	1,106,715	18	19,920,870
Sensors		N/A	2	0
NLOS-AD		741,000	6	4,446,000
Total equipment costs extended - FY 90 $ (80%)				1,182,547,270
Total materiel acquisition costs FY 90 $ (100%)				1,478,184,088

Table F-I-18. AIRCR MPA costs

Personnel	Authorized	Average MPA	MPA FY 90 $
Officer	252	$45,881	$11,562,012
Warrant officer	284	37,206	$10,566,504
Enlisted	3296	22,917	$75,534,432
Total	3832		$97,662,948
Total 20 years			$1,953,258,960

Table F-I-19. AIRCR OPTEMPO costs FY 90 $

Nomenclature	LIN	Qty	OP Temp	Spare $/UofM	Rpr Pts $/UofM	POL $/UofM	Total recurring
81mm mortar system	M02114	8	1232	1.68	4.8	0.55	$69,288
How md twd M198 155mm	K57821	16	1092	9.07	14.4	0	410,068
NLOS-AD		6					138,978
LAB (lt aslt brdg 60 ft)	Z11216	6	290	0	428.98	0	746,425
Launch M60 ser tk chas	L43664	6	527	48.94	23.03	1.88	233,514
Amd cmbt trct HS M9 (ACE)	W76473	16	1029	8.35	12.57	5.93	442,058
Trac dsl w/excv & fl(SEE)	Z90445	2	709	0.91	7.63	3.47	17,030
LH/LB	Z33524	74			174.66		3,461,204
EH-60A	H30616	3	182	858.93	174.66	114.2	626,693
UH-60A	K32293	54	258	858.93	174.66	114.2	15,991,010
Avenger	Z27724	18	1151	65.26	16.31	0.55	1,701,362
Trk utl M1037 w/S250 shl	T07543	18	364	0.05	0.24	0.07	2,359
HMMWV M998 cgo/trp car	T61494	328	4486	0.05	0.24	0.07	529,707
Trk amb 4 ltr (HMMWV)	T38844	12	364	0.05	0.24	0.07	1,572
Trk cgo 2 1/2T	X40009	95	3545	0.02	0.82	0.19	346,878
Trk van 2 1/2T M109A3	X62340	6	224	0.19	0.82	0.19	1,613
Trk 5T M924A1	X40831	122	1790	0.2	1.05	0.2	316,651
AIRCR OPTEMPO costs	X59326	9	8912	0.2	0.29	0.18	53,739
Trk trac 5T M932A2 w/w	X59463	53	8912	0.2	0.29	0.18	316,465
Wrecker, 5T M936A2	X63299	6	1766	0.2	0.67	0.6	15,576
Trk wrkr M984A1 HEMMT	T63093	3	1107	0.2	0.67	0.6	4,882
CL steam HI pre WT JT	C32887	1	396	0	1.06	6	2,796
Dispenser mine M128	D20529	2	178	0	29.75	0.1	10,627
Gen SM mech pulse jet	J30492	8	72	0	2.11	0	1,215
Gen ST TM PU-405A/M	J35492	9	279	0	1.1	1.5	6,529
Gen ST TM PU-625/G	J46252	2	352	0	1.1	0.6	1,197
Heater MIL H11049	K24862	31	246	0	0.82	0	6,253
Total OPTEMPO costs FY 90							25,455,689
Total OPTEMPO costs FY 90 $ - 20 years							509,113,780

Table F-I-20. AIRCR force costs

Type cost	FY 90 dollars	FY 92 dollars
Nonrecurring Recurring (20 yr OPTEMPO)	$1,478,184,088 $509,113,780	$1,606,490,466 $553,304,856
Total without personnel	$1,987,297,868	$2,159,795,322
20 year MPA (unit)	$1,953,258,960	$2,122,801,838
Total with personnel	$3,940,556,828	$4,282,597,160

Table F-I-21. AIRCR recap FY 92 dollars

Equipment & OPTEMPO	Unit Log Decision cost	$2,159,795,322 $116,897,000 $2,276,692,322
MPA	Unit Log Total MPA	$2,122,801,838 $956,700,000 $3,079,501,838
Total		$5,356,194,160

Table F-I-22. MIB nonrecurring costs

Major item of equipment	LIN	Unit cost	Qty	Total cost
Armored gun system	Z06764	$2,600,000	27	70,200,000
Future scout vehicle (S)		651,000	26	16,926,000
Future scout vehicle(C) w/AMS-H		1,025,736	53	54,364,008
Carrier 120mm mort (less mort) twd	Z44384	8,681	17	147,577
Mortar 120mm on mount	Z20400	19,084	17	324,428
How towed light 155mm		950,000	24	22,800,000
FF radar AN/TPQ36	Z52237	206,683	1	206,683
MMs AN/TMQ-31	M04941	1,280,848	1	1,280,848
81mm mortar	M02114	23,000	18	414,000
AAWS-M		230,000	36	8,280,000
AMS-H		163,736	24	3,929,664
Rifle snipers	R95387	5,145	12	61,740
Lchr grenade SS rifle 40mm M203	L44595	565	120	67,800
MG lt 5.56 M249	M09009	1,570	156	244,920
LAB (lt assault brdg 60 ft)	Z11216	59,419	3	178,257
Launch M60 ser tk chassis transp	L43664	527,126	3	1,581,378
Amd cmbt trct HS M9 (ACE)	W76473	750,817	9	6,757,353
Lchr mine clear line CHG (MICLIC)	L67342	7,000	6	42,000
Volcano dispenser mine M139	D30897	60,000	2	120,000
Trct dsl w/exv & fnt ldr (SEE)	Z90445	74,884	9	673,956
LH/LB		8,200,000	25	205,000,000
EH-60A	H30616	5,544,861	3	16,634,583
UH-60A	K32293	4,600,000	34	156,400,000
AFARE	H94893	8,899	4	35,596
UAV-C (air veh TADARS)	Z62820	2,442,308	20	48,846,160
GBCS (ser=HMMWV+$1M equip tlr)	Z32417	1,025,000	6	6,150,000
CGS		N/A	1	0
Elec shop AN/ASM-146C shelter	H01907	45,349	2	90,698
Elec shop AN/ASM-147B shelter	H01912	41,244	3	123,732
M157 smoke generator	G51840	18,524	8	148,192
M17 sanators	D82404	17,888	6	107,328
NBCRS mtd on HMMWV		N/A	6	0
65 GPM pump	P91756	1,377	8	11,016
XM1015 (lt) [M1015A1 cgo ft]	C10858	174,666	6	1,047,996
Trk util M1037 w/S250 shltr	T07543	24,308	18	437,544
HMMWV M998 cgo/trp car	T61494	25,000	540	13,500,000
Trk ambulance 4 ltr (HMMWV)	T38844	44,381	13	576,953
Trk cgo 2 1/2T	X40009	41,822	152	6,356,944
Trk van 2 1/2T M109A3 w/w	X62477	75,420	6	452,520
Trk cgo 5T M924A1	X40831	43,737	156	6,822,972
Trk tractor 5T M932A2	X59326	68,724	9	618,516
Trk tractor 5T M932A2 w/w	X59463	72,640	37	2,687,680
Trk tractor HET M911	T61035	117,271	6	703,626
Trk PLS w/tlr	Z40498	158,468	4	633,872
Trk HI MOB contact	Z77299	33,663	7	235,641
Wrecker, 5T M936A2	X63299	135,775	14	1,900,850

Major item of equipment	LIN	Unit cost	Qty	Total cost
Trk wrecker M984A1 HEMMT	T63093	179,715	2	359,430
Trk cgo 5T DS M925A2 w/w	X40931	73,275	16	1,172,400
Trk FS 2.5KGL M978 8x8 HEMMT	T58161	160,228	7	1,121,596
Trk cgo 8x8 TAC w/lt crane	T59278	124,313	6	745,878
RT forklift DSL 6000lb cap	X48914	32,550	9	292,950
RT forklift DSL 4000lb cap	T49255	23,659	2	47,318
TPU (tk-pump-unit 13217E7130)	V12141	7,152	9	64,368
Tank liq dispenser, trk mtd	V19950	1,825	6	10,950
Trailer 3/4T M101A2	W95537	2,251	202	454,702
Trailer cgo 1 1/2T	W95811	3,944	143	563,992
500 Gal blivets (tanks FAB 66x36)	V14744	1,097	12	13,164
Tlr ammo 1 1/2T M332	W94030	5,149	33	169,917
Tlr ammo 2 1/2T (Tlr Util)	W94441	1,186	5	5,930
Water tlr M149A2	W98825	5,518	41	226,238
Kit field mtd on trailer M103A3	L28351	27,086	19	514,634
Trailer FB 11T HEMAT M989	T45465	11,625	7	81,375
Semitrailer 12T (LB wkr M270A1)	S70243	18,673	1	18,673
Semitrailer LB HET 60T	S70661	70,564	6	423,384
Semitrailer FB 22.5T	S70027	15,542	33	512,886
Gen DSL 15kw 60hz on M200A1	J35492	20,039	2	40,078
Gen DSL 30kw 60hz on M200A1	J36383	20,810	6	124,860
Gen DSL 60kw 60hz on M200A1	J35629	23,731	4	94,924
Welding shop tlr mtd	W48391	25,050	1	25,050
Crane Tk CAT RT41AA	F43003	57,887	1	57,887
Maint shops (S/E A/R FM sup #1)	T25619	20,874	17	354,858
Elec shop stlr mtd AN/ASM189 L/P	H01855	109,665	4	438,660
Hvy rpr veh (armored maint veh)	Z06157	498,538	6	2,991,228
Avenger (PMS) (FU FAAD LOS-R/PMS)	Z77248	1,106,715	18	19,920,870
Sensors		N/A	2	0
NLOS-AD		741,000	6	4,446,000
Total equipment costs extended - FY 90 $ (80%)				$693,417,231
Total materiel acquisition cost FY 90 $ (100%)				$866,771,539

Table F-I-23. MIB MPA costs

Personnel	Authorized	Average MPA	MPA FY 90 $
Officer	310	$45,881	$14,223,110
Warrant officer	154	37,206	5,729,724
Enlisted	4487	22,917	102,828,579
Total	4951		122,781,413
Total 20 years			2,455,628,260

Table F-I-24. MIB OPTEMPO costs FY 90 $

Nomenclature	LIN	Qty	OP Temp	Spare $/UofM	Rpr Pts $/UofM	POL $/UofM	Total recurring
Armored gun system		27					$695,007
Future scout veh (S)		26					532,038
Future scout veh (C)		53					1,420,029
120mm mort carr twd		17	1232	1.68	4.8	0.55	147,236
Carr cgo ft M1015A1	C10858	6	830	2.3	4.13	0.55	34,760
How towed lt 155mm		24	1092	9.07	14.4	0	615,102
NLOS-AD		6					138,978
LAB (lt aslt brdg 60 ft)	Z11216	3	290	0	428.98	0	373,213
Launch M60 tk chas	L43664	3	527	48.94	23.03	1.88	116,757
Amd cmbt trct HS M9 (ACE)	W76473	9	1029	8.35	12.57	5.93	248,658
Trac dsl w/Excv & fl(SEE)	Z90445	9	709	0.91	7.63	3.47	76,636
LH/LB	Z33524	25					1,169,326
EH-60A	H30616	3	182	858.93	174.66	114.2	626,693
UH-60A	K32293	34	258	858.93	174.66	114.2	10,068,414
Avenger	Z27724	18	1151	65.26	16.31	0.55	1,701,362
Trk util M1037 w/S250	T07543	14	364	0.05	0.24	0.07	1,835
HMMWV M998 cgo/trp car	T61494	540	4486	0.05	0.24	0.07	872,078
Trk amb 4 ltr (HMMWV)	T38844	13	364	0.05	0.24	0.07	1,704
Trk cgo 2 1/2T	X40009	152	3545	0.02	0.82	0.19	554,466
Trk van 2 1/2T M109A3	X62340	6	224	0.19	0.82	0.19	1,613
Trk cgo 5T M923A2	X40794	16	4203	0.2	0.29	0.18	45,056
Trk 5T M924A1	X40831	156	1790	0.2	1.05	0.2	404,898
Trk tractor 5T M932A2	X59326	46	8912	0.2	0.29	0.18	274,668
Wrecker, 5T M936A2	X63299	14	1766	0.2	0.67	0.6	36,344
Trk wrkr M984A1 HEMMT	T63093	2	1107	0.2	0.67	0.6	3,255
CL steam HI pre WT JT	C32887	1	396	0	1.06	6	2,796
Dispenser nine M128	D20529	2	178	0	29.75	0.1	10,627
Gen SM mech pulse jet	J30492	8	72	0	2.11	0	1,215
Gen ST TM PU-405A/M	J35492	4	279	0	1.1	1.5	2,902
Gen ST TM PU-625/G	J46252	2	352	0	1.1	0.6	1,197
Heater MIL H11049	K24862	31	246	0	0.82	0	6,253
Total OPTEMPO costs FY 90 $							20,185,116
Total OPTEMPO cost FY 90 $ - 20 years							403,702,320

Table F-I-25. MIB force costs

Type cost	FY 90 dollars	FY 92 dollars
Nonrecurring	$866,771,539	$942,007,309
Recurring (20 yr OPTEMPO)	$403,702,320	$438,743,681
Total without personnel	$1,270,473,859	$1,380,750,990
20 year MPA (unit)	$2,455,628,260	$2,668,776,793
Total with personnel	$3,726,102,119	$4,049,527,783

Table F-I-26. MIB recap FY 92 dollars

Equipment & OPTEMPO	Unit Log Decision cost	$1,380,750,990 $84,626,000 $1,465,376,990
MPA	Unit Log Total MPA	$2,668,776,793 $731,240,000 $3,400,016,793
Total		$4,865,393,783

Table F-I-27. LIA recurring MPA costs (FY 92 $) ACR, MACR, AIRCR

Unit	OFF	WO	ENL	Total	Annaul MPA
Veternarian det	1	0	5	6	$205,000
Prev med det	8	0	11	19	1,004,000
Finance tm	3	0	31	34	1,107,000
JAG tm	3	0	2	5	277,000
Maint co	10	10	380	400	11,748,000
Wheel rpr tm	0	0	12	12	380,000
TTP	2	0	30	32	938,000
Md trk co (petro)	8	2	344	354	10,798,000
Md trk co (cgo)	4	1	186	191	5,745,000
Md trk co (wtr)	4	1	186	191	5,745,000
Term service	5	1	355	361	9,888,000
Total				1605	47,835,000
Total 20 years					956,700,000

Table F-I-28. LIA recurring MPA costs (FY 92 $) LCR, MIB

Unit	OFF	WO	ENL	Total	Annual MPA
Veternarian det	1	0	5	6	205,000
Prev med det	8	0	11	19	1,004,000
Finance tm	3	0	31	34	1,107,000
JAG tm	3	0	2	5	277,000
Maint co	5	5	190	200	5,874,000
Wheel rpr tm	0	0	12	12	380,000
TTP	2	0	30	32	938,000
Md trk co (petro)	4	1	172	177	5,399,000
Md trk co (cgo)	4	1	186	191	5,745,000
Md trk co (wtr)	4	1	186	191	5,745,000
Term service	5	1	355	361	9,888,000
Total				1228	36,562,000
Total 20 years					731,240,000

Table F-I-29. LIA costs (FY 92 $) ACR, MACR, AIRCR

Unit	Equipment	Total nonrecurring	Total OPTEMPO
Veternarian det	$88,000	$129,000	$0
Prev med det	175,000	257,000	5,000
Finance tm	199,000	334,000	13,000
JAG tm	3,000	40,000	0
Maint co	16,330,000	18,326,000	422,000
Wheel rpr tm	2,900,000	3,076,000	20,000
TTP	1,166,000	1,342,000	18,000
Md trk co (petro)	19,262,000	21,656,000	806,000
Md trk co (cgo)	7,979,000	9,206,000	403,000
Md trk co (wtr)	7,979,000	9,206,000	403,000
Term service	8,401,000	9,665,000	93,000
Total		73,237,000	2,183,000
Total 20 years			43,660,000

Table F-I-30. LIA costs (FY 92 $) LCR, MIB

Unit	Equipment	Total nonrecurring	Total OPTEMPO
Veternarian det	88,000	129,000	0
Prev med det	175,000	257,000	5,000
Finance tm	199,000	334,000	13,000
JAG tm	3,000	40,000	0
Maint co	8,165,000	9,163,000	211,000
Wheel rpr tm	2,900,000	3,076,000	20,000
TTP	1,166,000	1,342,000	18,000
Md trk co (petro)	9,631,000	10,828,000	403,000
Md trk co (cgo)	7,979,000	9,206,000	403,000
Md trk co (wtr)	7,979,000	9,206,000	403,000
Term service	8,401,000	9,665,000	93,000
Total		53,246,000	1,569,000
Total 20 years			31,380,000

Table F-I-31. Total LIA costs (FY 92 $)

Force	Non-recurring	OPTEMPO	Total CSS	MPA	Total w/personnel
ACR	73,237,000	43,660,000	116,897,000	956,700,000	1,073,597,000
MACR	73,237,000	43,660,000	116,897,000	956,700,000	1,073,597,000
LCR	53,246,000	31,380,000	84,626,000	731,240,000	815,866,000
AIRCR	73,237,000	43,660,000	116,897,000	956,700,000	1,073,597,000
MIB	53,246,000	31,380,000	84,626,000	731,240,000	815,866,000

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APPENDIX G

LOGISTICS IMPACT ANALYSIS

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APPENDIX G

LOGISTICS IMPACT ANALYSIS (LIA)

G-1. Purpose. To assess the logistic impacts of augmenting an ALO contingency corps with alternative regimental-sized units. The contingency corps may or may not contain an ACR, but the ACR will be the base case for this analysis for comparative purposes. The type of augmentation will be either a MACR, a LCR, an AIRCR, or an MIB.

G-2. Discussion.

a. *Objective.*

(1) Determine supply sustainment, CSS force structure requirements (supply, transportation, maintenance), and maintenance impacts of introducing alternative regimental-sized units into a contingency corps.

(2) Provide personnel and equipment impacts for each alternative to TRAC-WSMR for costing purposes.

(3) Rank the alternatives in terms of total support requirements identified in this LIA. The ranking will disregard any other characteristics (e.g., combat effectiveness, deployability, cost) of the alternatives.

b. *Scope.*

(1) The analysis determined the logistics force structure impacts of an ACR and each alternative in a SWA theater. The primary source of scenario and theater characteristic data was the SRA 96 SWA scenario as portrayed by CAA. The SRA process was based on the Defense Guidance Illustrative Planning Scenario for SWA in FY88-89. The Operation Desert Shield supportability analysis scenario developed by CAA in November 1990 also provided insights.

(2) The analysis examined supply sustainment requirements for all classes of supply with particular attention to those classes that are most variable by equipment type and density and by the level of combat/unit activity: classes III, V, VII, and IX. A description of the classes of supply is shown in figure G-1.

(3) The analysis examined maintenance manhour and mechanic requirements differences under current support concepts (ALB/AOE) across the alternatives.

Class I	-	Subsistence
Class II	-	Clothing, tools, individual equipment, administrative and housekeeping supplies
Class III	-	Petroleum fuels, oil, lubricants
Class IV	-	Construction and barrier materials
Class V	-	Ammunition
Class VI	-	Personal demand items
Class VII	-	Major end items
Class VIII	-	Medical supplies
Class IX	-	Repair parts

Figure G-1. Classes of supply

(4) The analysis focused on the added support requirements of placing the alternative units into a corps force structure. Internal support requirements were assumed to be adequately addressed in the design of each alternative.

c. *Constraints.*

(1) This impact analysis was constrained in scope and depth by the specific study objectives and timeline.

(2) Due to the low resolution of data defining the alternative units, maintenance manpower requirements are only expressed in terms of direct productive (enlisted) spaces. Any attempt to apply SGA (AR 611 series - Military Occupation Classification, Structure, and Implementation) and assign supervisory spaces to what would be marginal changes within a corps context, would be purely conjectural.

d. *Alternatives.*

(1) Base case - A contingency corps containing an ACR, SRC 17440L000.

(2) A contingency corps augmented with an ACR modernized by the addition of selected ASM vehicles (tank, advanced field artillery system-cannon (AFAS-C)) and the LH.

(3) A contingency corps augmented with the LCR (Armor school alternative).

(4) A contingency corps augmented with the AIRCR (Aviation school alternative).

(5) A contingency corps augmented with the MIB (Infantry school alternative).

e. *Methodology.*

(1) General overview. An overview of the methodology used in performing the LIA is graphically depicted in figure G-2. Comparative analysis was performed to determine differences in requirements among the alternatives in each of the following areas:

(a) Maintenance and supply.

(b) CSS force structure.

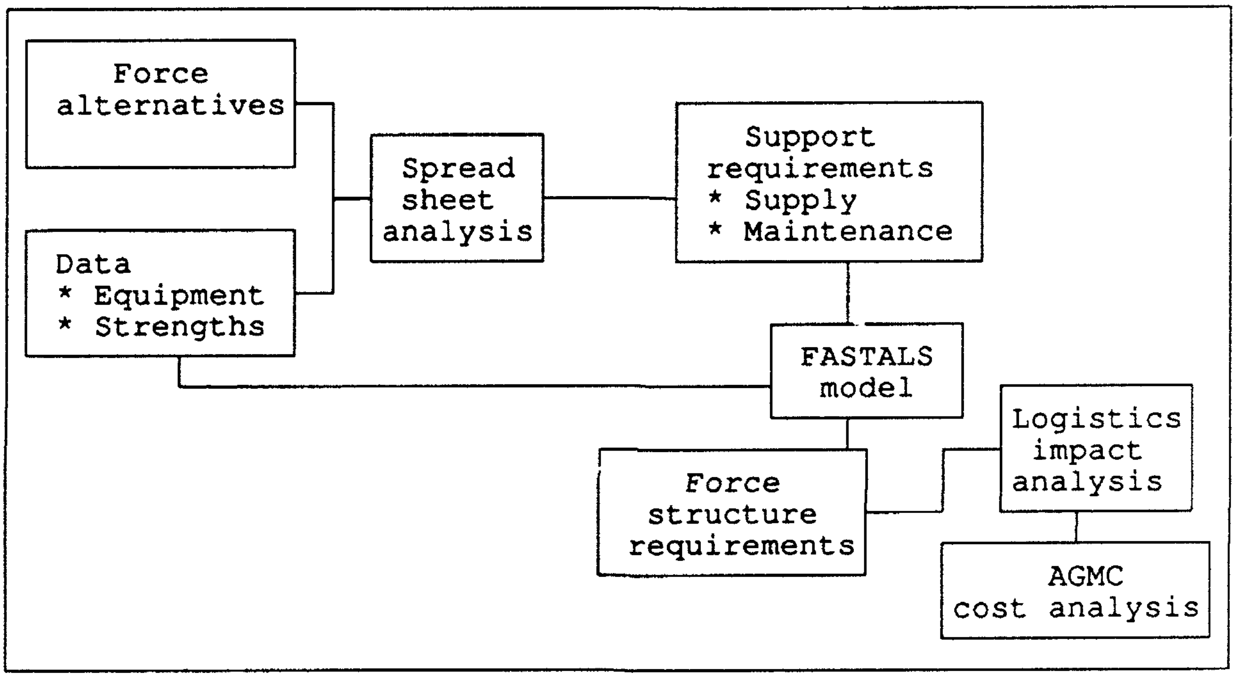

Figure G-2. LIA overview

(2) Maintenance and supply analysis. This analysis was based primarily on results produced using automated spreadsheets.

(a) Maintenance. The maintenance requirements for the base case and each alternative were determined using spreadsheet aggregation of the AMMH requirements for the primary equipment by LIN and density in the base case and each alternative regiment/brigade. The AMMH requirements were converted into mechanic manpower requirements using Department of the Army (DA) designated productivity factors for ground systems and productivity factors from the maintenance TOE header codes for aviation systems. Maintenance manhour requirements were also used as input to the FASTALS model to determine total maintenance unit requirements.

(b) Supply. The determination of supply requirements was a two-phase process.

1. The first phase was a spreadsheet aggregation of supply planning factor data from the Combined Arms Support Command (CASCOM)-managed logistics data base. The average daily requirements determined for selected classes of supply (III, V, VII, IX) for the base case and each alternative. The classes of supply selected for this phase of the analysis are the most sensitive to both equipment type and density and to the level of combat or unit activity. These internal unit requirements are used in the second phase to determine overall requirements (internal plus external).

2. The second phase used the FASTALS model to calculate the average daily tonnage required for each class of supply for both the ACR and each alternative regiment and for their respective supp· ·ting "tail." Consumption data for the classes of supply determined in the fi · phase were used as input to FASTALS. The other classes of supply which are population driven as opposed to equipment driven and do not vary by unit activity in the model (classes I, II, IV, VI, VIII, and water) were obtained from the SRA 96 SWA and Desert Shield planning rates originally provided by CASCOM.

(3) CSS force structure analysis. A logistical force structure assessment was conducted to determine additional logistics force structure requirements for each alternative at echelons above division using the DA theater-level force roundout model, FASTALS. The results of this analysis are expressed at the SRC level of detail which identifies personnel and equipment requirements for costing purposes.

f. *MOP for the base case and each alternative.*

(1) AMMH by MOS.

(2) Supply requirements:

(a) Class III and water expressed in gallons/day.

(b) All other classes of supply expressed in STONs/day.

(3) CSS force structure differences by SRC and quantity for the base case and each alternative.

G-3. Maintenance analysis. This portion of the analysis addresses the specific maintenance requirements generated by the equipment of the ACR and each alternative. The maintenance

force structure impacts of the alternatives and their support slice (support to support) are addressed in the force structure portion of the analysis.

a. *Background.* Maintenance positions (and other positions in a TOE not derived from doctrinal sources) are determined by criteria in AR 570-2, Army MARC. Those criteria have been further modified by TRADOC Pamphlet 71-6, dated 17 September 1990, and message 011601Z June 1988, Commander TRADOC, ATTN: ATCL-OM, subject: MARC Computation of Maintenance Positions in TOE. The modifications affect the manner in which maintenance manpower requirements are computed for two categories of maintenance:

(1) Maintenance other than aviation. The AMMDB which is monitored and updated by CASCOM, identifies maintenance manhours at unit, DS, and GS levels of maintenance on a per LIN basis. Those manhours are converted into manpower requirements using productivity factors determined by the unit category as defined in AR 310-25 and shown in table G-1. Manhours for the ASM systems in the MACR were extracted from the ASM Cost Operational Effective Analysis (COEA).

(2) Aviation maintenance. Maintenance manhour requirements on a per LIN basis for aircraft are determined from the DA approved wartime flying hours and the AVIM and AVUM ratios contained in AR 570-2 distributed for comment on 13 Jun 91 by the U.S. Army Force Integration Support Activity. The Aviation Logistics Center's MARC spreadsheet was used to perform the manhour and mechanic calculations and the spreadsheet uses the information contained in the draft regulation. Although the draft AR 570-2 is not yet approved, the use of it at this time is consistent with the TOE development work currently being done by the Aviation Logistics Center in support of ALO. Productivity factors for aviation units are based on 8.0 productive hours per day (2,920 per year) for AVUM mechanics and 8.54 productive hours per day (3,118 per year) for AVIM mechanics.

Table G-1. Annual manhour productivity factors

Category of TOE	Description	Productive Manhours
I	Combat unit	2,500
II	CS & CSS unit in combat zone	2,700
III	Units operating in the communication zone	3,100

(3) AMMH.

(a) The AMMH for the base ACR and each alternative are summarized in tables G-2 and G-3. The supporting detailed date is aggregated by MOS series in tables G-I-1 through G-I-5 in annex I. The manhours indicate the relative workload differences between the ACR and the alternatives. The primary workloads generated are in the areas of mechanical maintenance (MOS series 41-63) and aviation maintenance (MOS series 67-68).

(b) Aircraft requirements are high relative to the number of aircraft because of the high maintenance ratios (manhours per flying hour) associated with helicopters. This is particularly evident in the AIRCR with its high density of aircraft (131) relative to the other alternatives (68/74/75/62 for the ACR/MACR/LCR/MIB, respectively).

(c) The ACR has the highest level of mechanical maintenance relative to the alternatives due to its high density of heavy armored vehicles. This tends to distort the ratio of mechanical maintenance to aircraft maintenance compared to the LCR and MIB since the difference in numbers of aircraft only varies by 13 between them.

Table G-2. AMMH

	Unit/AVUM	DS/AVIM	GS
Mechanical			
ACR	855974	423237	249590
MACR	869604	317125	189472
AIRCR	410621	128913	92325
LCR	570466	132293	90343
MIB	478771	137310	90783
Aviation			
ACR	686200	383514	*
MACR	817600	137192	
AIRCR	1427880	361688	
LCR	826360	137192	
MIB	668680	236968	
Other			
ACR	19059	50998	25866
MACR	16853	31950	7211
AIRCR	35131	26953	27535
LCR	37662	8283	6605
MIB	41850	10728	8198

* Under current aviation maintenance schedules there is AVIM, AVUM, and DEPOT, but no GS.

Table G-3. Total AMMH

	Unit/AVUM	DS/AVIM	GS	Total
ACR	1561233	857749	275456	2694438
MACR	1704057	486267	196683	2387007
AIRCR	1873632	517554	119860	2511046
LCR	1434488	277768	96948	1809204
MIB	1189301	385006	98981	1673288

b. *Maintenance manpower requirements.*

(1) The maintenance manhours determined above are converted into manpower spaces by dividing by the appropriate productivity factors. The determination of the manhours and of the proper productivity factors is the essence of the MARC process. Mechanic requirements are summarized in table G-4. The supporting detailed data by MOS is shown in tables G-I-6 and G-I-7 in annex I. Each MOS with a numerical man-year quantity of .5 or greater is recognized as a legitimate requirement necessary to provide the maintenance skill at the appropriate maintenance level for the TOE selected. Fractions of .5 or higher are rounded to the next higher whole number. Since the ACR and the alternatives are functionally "separate" organizations (as opposed to divisional), they must provide for the bulk of their own support.

(2) The number of mechanics determined to be required at the Unit/AVUM and DS/AVIM levels are assumed to be adequate and already included in the support squadrons or support battalions of all these organizations. The personnel for these spaces will therefore already be accounted for in the unit strengths.

Table G-4. Mechanic requirements

	Unit/AVUM	DS/AVIM	GS
ACR	592	299	88
MACR	636	176	65
AIRCR	667	164	29
LCR	524	94	32
MIB	430	127	32

(3) Modernization of the ACR according to the scheme provided for this analysis (substitution of the LH for attack and observation helicopters) would require a redesign of the aviation maintenance structure. Redesign would be necessary because the maintenance support concept for the LH is a two-level concept as opposed to the three-level concept of the other aircraft. In addition, the LH requires entirely different skills. For this analysis, the reduction in mechanics at the Unit/AVUM plus DS/AVIM level for the modernized ACR will

not influence the LIA results and will therefore be ignored. The modernized ACR will be played at its study defined strength of 4,656 personnel.

(4) The support which must be provided from outside the units has not yet been accounted for. The maintenance spaces identified for GS have force structure (green suit) implications and must therefore be reported and included separately for cost purposes. The manner in which these spaces would be treated in the force structure is speculative. They could be either picked up by excess capability within existing GS units in a theater of operations or they could be handled through augmentation of existing units.

(5) The ACR has the highest (GS) maintenance requirement. This is due to the high density of armored vehicles in the TOE which have more maintenance done at the GS level of maintenance. The ASM systems lower that requirement for the MACR. The AIRCR has the next highest overall requirement for mechanics which is being driven by the high aircraft density. Although the total strength of the AIRCR is less than that of the ACR, its higher internal requirement for maintenance means that its "tooth to tail" ratio is going to be lower.

G-4. Supply impacts.

a. *General.* The TRADOC Commander is the Executive Agent for the Deputy Chief of Staff for Logistics for Army logistics planning factors management as outlined in AR 700-8. CASCOM is the logistics planning factors manager for the Army and developed the Logistics Planning Factors Data System (LPFDS) to store, process, and disseminate approved planning factors for all classes of supply. CASCOM provides logistics planning factors to customers Department of Defense (DOD) wide to support both combat developments, and joint, strategic, contingency, and operational planning. The LPFDS has the capability of reporting only aggregated force data at the SRC level or detailed data at the LIN level. Factors are typically developed for all consuming items for each SRC in a force. Since the three alternative regiments do not have entries in the TRADOC TOE files, the standard LPFDS consumption reports could not be produced [Product 6 - class VII, Product 10 - class V, Product 11 - class III, and a Class IX Report (no product number)]. Only the base ACR (SRC 17440L000) requirements could be determined using standard reports. Supply requirements for the alternative regiments were derived manually using LIN item data and densities. Consumption data for the ASM systems in the modernized ACR were derived from the ASM COEA.

b. *Data types.* Supply data can be divided into two categories:

(1) Classes of supply that are sensitive to LINs and density and to the level of unit combat activity (intense, moderate, reduced, reserve). Classes III, V, VII, and IX fall into this category. The rates that CASCOM provides are considered to be of moderate intensity. In this analysis, the moderate rates are considered sustainment rates.

(2) Classes of supply that are sensitive to population more than to equipment are considered not to vary by intensity and/or are considered theater independent. Classes I, II, IV, VI, and VIII fall into this category. The representation of the rates is particularly important in an accounting model like FASTALS where a warfighting simulation like CEM or the Force Evaluation Model provide intensity posture profiles for the combat units and the total consumption of supplies is a major determinant in CSS force structure requirements.

c. *AGMC supply data.* CASCOM provided the most current SWA rates for classes III, V, VII, and IX for the base ACR, SRC, and for the equipment LINs in the alternative regiments. The rates that were provided (table G-I-11 in annex I, LINs in parenthesis are surrogates either completely (in the left column)) or for certain rates only (in the column for the appropriate supply class) are consistent with the rates provided for the campaign planning for Operation Desert Storm, the FY91 Joint Strategic Capability Plan, and TAA-99. The specific rates and source by supply class are:

(1) Class III - Mideast Programming Rates for FY91 (P91M).

(2) Class V - 80 percent of the European Programming Rates for FY90 (80 percent P90E). The decision to use European rather than Mideast rates was a Deputy Chief of Staff for Operations (DCSOPS) decision, memorandum (classified SECRET), DAMO-FL, 16 August 1990, subject: Munitions Requirements, OPERATION DESERT SHIELD.

(3) Class VII - P91M.

(4) Class IX - CASCOM Class IX Planning Factors Study, August 1984. These rates are the only currently approved (DCSLOG, March 1985) class IX rates available.

(5) All other classes of supply and water. Rates (table G-5) were extracted from the most current SWA FASTALS planning factor table (Desert Storm).

Table G-5. Nonvariable planning factors (lbs/man/day)

Class	Factor
I	7.06
II	3.67
IV	8.50
VI	3.40
VIII	1.22
Water	166.8

d. *ACR data.* Variable planning factor data for the base ACR was obtained from the LPFDS standard product reports for classes III, V, VII, and IX. Data for the MACR was developed by subtracting the data for the systems to be replaced from the standard report results and substituting the appropriate consumption data for the replacement systems. This then generated a new composite MACR planning factor. The replacement system data came either from that already provided by CASCOM or from the ASM COEA. Since no data was available for the FMTV systems in the MACR, those systems remained as they were. The variable rates that were produced for the base ACR and for the MACR are shown in table G-6. The nonvariable rates remain the same as those used in the other alternatives. Specific ACR impacts are:

Table G-6. ACR variable rate planning factors (lbs/man/day)

Class	ACR	MOD ACR
III	111.25	110.25
V	79.46	91.37
VII	169.0	167.0
IX	13.67	12.71

(1) Class III. The reduction in class III for the MACR is driven by the 47 percent decrease in fuel consumption of the Block III tank over the M1A1/2. This reduction was produced by the introduction of the Advanced Integrated Propulsion System. The overall reduction is attenuated by the increase in fuel consumption caused by the increased flying hours (paragraph G-3a(3)(d)) of the LH over the AH-1 and OH-58 helicopters.

(2) Class V. The AFAS-C has a 19 percent increase in average firing rate over the Howitzer improvement program (303 vs 254 rounds per tube per day). This rate was based on a European scenario for this analysis; the consumption for the 155 self-propelled (SP) in the base ACR was increased by 19 increase. A slight increase was also gained in class V consumption for the MACR by converting the OH-58s to LHs.

(3) Class VII. The ASM weight reduction of the Block III tank over the M1A1/2 reduced the class VII requirement.

(4) Class IX. The slight reduction for the MACR was generated by the ASM vehicles over their predecessors.

e. *AGMC daily sustainment requirements.* Table G-7 displays the daily sustainment requirement expressed in STONS per day or gallons per day for the base ACR and each of

the alternative regiments. These requirements are only for the units themselves and do not include the sustainment requirements for the support slice ("log tail") necessary to actually place these units in a theater of operations. That portion of the analysis will be conducted using the FASTALS model to determine the additional sustainment requirement for the ACR and alternatives. There are several sustainment relationships that need further explanation:

(1) Class III. The ACR has the highest class III requirement due to the weight of its organic equipment. All of the units are 100 percent mobile and therefore have a large number of SP vehicles. There is a strong relationship between the weight of ground systems and their fuel consumption. Aircraft (helicopters) consumes fuel at a much higher rate relative to their weight than do ground systems. Since the ACR is 2 to 2.5 times heavier than the alternatives (22,687 STONS), it has the highest daily fuel requirement. Among the non-ACR alternatives, the AIRCR is the lightest (9,210 STONS), but has the highest fuel requirement due to the high density of aircraft compared to the LCR and MIB.

Table G-7. Daily unit sustainment requirements (STONS/day or gals/day)

Class	ACR	MACR	LCR	AIRCR	MIB
I	16.59	16.43	17.48	14.45	17.47
II	11.31	11.20	10.81	9.85	11.91
III	74393	73019	50260	70162	47601
IV	19.98	19.79	19.11	17.40	21.04
V	186.7	212.7	132.0	107.8	174.9
VI	7.99	7.92	7.64	6.96	8.42
VII	397.2	388.8	227.3	81.90	119.5
VIII	2.87	2.84	2.74	2.49	3.02
IX	12.62	11.66	5.55	3.77	4.67

(2) Class V. Ammunition impacts the logistics system primarily through its weight (transporting, handling, storing). Three categories of ammunition make up between 90 and 96 percent of the total weight of ammunition required on a daily basis across the alternatives. The categories are 81mm mortar, 120mm mortar (surrogated with 107mm), and 155mm howitzer. Among these three categories, the howitzer constitutes between 83 and 90 percent of the total weight. The ACRs and MIB have the highest requirement for ammunition because they have the highest density of howitzers (24 vs 16) and mortars. The MACR has the highest consumption of all because it has the ASM AFAS-C with its autoloader and high

rate of fire. Without the howitzers, the LCR and MIB would be approximately equal. Ninety percent of the AIRCR's ammunition weight is in howitzer ammunition which would place it far below the other alternative regiments without it. Primary ammunition types are shown in table G-8. The 120mm mortar is not included since it was surrogated by the 4.2 inch (107mm) mortar for weight approximation only.

(3) Class VII. Replacement requirements (expressed in pounds or STONS) for end items are a function of end item weight and of the replacement characteristics of the end item itself. Primary combat systems (e.g., tanks) have high replacement rates relative to other types of systems (trucks, trailers, etc). These rates are expressed as Wartime Replacement Factors rates.

Table G-8. Primary AGMC ammunition types

DODIC	Nomenclature
D501	Proj 155mm HE ADAM M69
D544	Proj 155mm HE DEEP CAV
D528	Proj 155mm HE SMK RP XM82
D505	Proj 155mm ILLUM M485
D550	Proj 155mm SMK WP M110
T864	Proj 155mm BB XM864
T898	Proj 155mm SADARM XM89
D502	Proj 155mm HE ADAM M73
D579	Proj 155mm HERA M549 series
D563	Proj 155mm HE ICM M483
D503	Proj 155mm AT RAAMS M7
D510	Proj 155mm CLGP
D509	Proj 155mm AT RAAMS M7
C276	Ctg 81mm SMK WP M373 M
C256	Ctg 81mm HE M374 Series
C226	Ctg 81mm ILLUM M301 Series
C699	Ctg 4.2 IN HE M329A2
C706	Ctg 4.2 IN ILLUM M335
C708	Ctg 4.2 IN SMK WP M328

The LCR has a high class VII requirement compared to the AIRCR and MIB because of the density and weight of the AGS (surrogated by the M551 armored airborne reconnaissance vehicle) and of the carrier for the 120mm mortar. Seventy-one percent of the LCR's class VII requirement is accounted for by those two systems. The ACR's requirements are significantly higher than any of the other alternatives because their equipment is much heavier and they have a higher number of primary combat systems (tanks, fighting vehicles, etc.) subject to catastrophic loss. To place the rates into perspective, the loss (destroyed, abandoned, captured) of a single M1 tank a day equates to a class VII requirement of approximately 60 tons a day.

(4) Class IX. Like class VII, the class IX requirements also have a high relationship to total unit weight. The heavier the equipment, the heavier the class IX requirement. The ACR requirements are probably a little out of proportion to the other alternatives because the CASCOM Class IX report considers all of the equipment in the TOE, and the alternatives are not sufficiently developed to have complete equipment lists. Since there is no way to factor degree of completeness into the class IX rates, the ACR rates will be used as shown.

G-5. CSS force structure impacts.

a. *General.* The primary tool used by the Army to determine CS and CSS force structure requirements is the FASTALS model. FASTALS was developed in 1971 as part of a large system of models known as the FOREWON System. Since then, it has been and continues to be used extensively in the preparation of input for the Army POM, the Army contribution to the Joint Strategic Planning Document Analyses, and many other studies. The results have been widely accepted throughout the Army staff.

(1) FASTALS is primarily used in force planning analyses where balanced, time-phased, geographically distributed force requirements are desired. Given a tactical situation, logistics capabilities, and theater policies, FASTALS can be used to determine the total force necessary to support the situation logistically. Using the results from a warfighting simulation (primarily combat unit postures over time), a scenario (in terms of theater description, policies, and characteristics, and the time-phased arrivals of combat units into the theater) and a Master file of available units, FASTALS computes the support force requirements necessary to round out the combat force.

(2) In this analysis, a contingency corps in SWA without an ACR is the base case. The ACR and alternative units will be added individually to the corps for FASTALS to identify the necessary additional supporting force structures. The combat postures of the ACR and alternatives will be varied parametrically to determine the sensitivity of the support force structure allocations to changes in consumption.

b. *Scenario description.* The SRA 96 SWA scenario represents a contingency airborne corps containing five divisions (airborne, airmobile, light, mechanized, and motorized infantry). It is an austere theater with no prepositioned supplies or equipment, no host nation support, and very little rail transport. The theater transportation system contains 10 seaports, 11 POL ports, 2 Logistics over-the-shore (LOTS) ports, 15 intertheater airports, and 10 intratheater airports.

(1) The primary transportation means is by highway, and the average distance from the ports to the division forward area is 501 miles, to the division rear area is 352 miles. A 60-mile and 151-mile POL pipeline support the division area.

(2) The scenario is 70 days in length with combat units beginning to arrive on day 2 (light division), the airborne and air assault on day 5, the motorized infantry on day 10, and the mechanized division on day 28. This scenario is excellent for the purposes of this

analysis because it does not include an ACR and, being an austere theater, there is very little slack in the support units already in the scenario.

(3) The addition of the ACR and alternative regiments means that the bulk of their support force structure costs must be added to the theater. It is therefore a more correct measure of the true support requirements of these units. The Desert Storm scenario as portrayed in the 1 November CAA FASTALS scenario file was a "fat" theater with a great deal of excess support capability which masked the true cost of adding these units to the force list.

c. *Transportation algorithm in FASTALS*. An understanding of the transportation algorithm in FASTALS is important because the impact of the consumption rates determined in the supply portion of this report primarily affects transportation units with a subsequent cascading effect into maintenance requirements. The process in FASTALS consists of two subprocesses, the materiel or supply process, and the transportation or distribution process. A detailed description of the two processes is contained in annex I.

d. *FASTALS results*. One of the primary inputs into FASTALS from the theater-level warfighting simulation is a profile of combat unit postures over time. In FASTALS, combat units are defined as any unit played explicitly in the theater-level war fighting simulation. Since the units under study in this analysis were not played when SRA 96 was conducted (1988-89), there is no profile for them. Therefore, the study units will be introduced individually into the scenario at three constant levels of activity - Intense (140 percent of moderate), Moderate, and Reserve (30 percent of moderate). This parametric approach will do two things:

-- Bracket the possible range of results had the units been played in the war fight simulation.

-- Determine how sensitive the allocation of support force structure is to variations in consumption levels for the ACR and each of the alternatives.

(1) Unit differences. Table G-9 summarizes the unit differences resulting from variation in consumption levels (REServe, MODerate, INTense) for the ACR and each alternative. The base case for all of the comparisons is the troop list from the original SRA 96 SWA run. The base case contains no ACR and none of the alternative regiments. The units were played individually without any attempt to play the ACR together with any of the alternatives or to play any of the alternatives together. For the purposes of this analysis, the individual requirements should be considered additive. That may not, however, be the case. The base corps population is 95,528 people. The ACR and all of the alternatives with their support slices only increase that by six to seven percent. Since everything in FASTALS is ultimately based on population, we are talking about a very small piece of a theater of operations. In the overall context, that needs to be kept in perspective. In the Desert Storm scenario with two corps, this piece is even more insignificant.

(2) Discussion.

(a) While there is some variation in the requirement for fuel and ammunition between the ACR and the alternatives, the units themselves are pretty much the same in terms of unit size (less than 5,000 people) and requirements with the exception of class VII and unit weight. Unit weight can affect some transportation workloads in terms of terminal or port servicing type operations (boat companies, terminal service, heavy crane, etc.). These are true requirements, but become lost in the overall context of a five division corps because the organizations providing the services would be needed at any rate and the phasing in of heavy units into a theater would spread the workload over a period of time so that one more brigade equivalent of heavy equipment (primarily the ACRs) would not really make much of a difference.

(b) The class VII sustainment requirement for the ACR and the alternatives is correct in this analysis, but there is an anomaly in the way that FASTALS handles it. Class VII is included in the "dry cargo" category along with other dry commodities and the workload to move dry cargo is satisfied by medium truck companies. The class VII consumption in this analysis consists predominantly of vehicles. Those vehicles are mobile or can be towed (trailers) or flown. Many of them are very heavy and the distances involved from the ports to the division forward area is around 500 miles in this scenario. The bulk of the class VII in this analysis would be moved by heavy equipment transporters (HETs) rather than medium truck companies with 15 ton trailers. The 55729L heavy truck company is allocated in FASTALS to move oversized, outsized class VII. Since there is no "oversized/outsized class VII" workload in FASTALS, the heavy truck companies are allocated 0.5 per heavy division and .167 per separate Armored Brigade or ACR. The heavy truck company has 36 HETS and, at 75 percent availability with two line haul or four local haul trips a day, the capability of the unit in tons per day is large. One truck company can handle two complete heavy divisions. The SRA 69 SWA scenario contains one heavy truck company to support one mechanized division. Its surplus capability can easily handle the ACR or any of the alternatives. There is no requirement in this scenario to assign additional heavy truck assets.

Table G-9. Support force structure differences
ACR, MACR, AIRCR

Unit	Differences from base (consumption level)							
	ACR/MACR/AIRCR				LCR/MIB			
	STR	RES	MOD	INT	STR	RES	MOD	INT
08149L0 Vet det	6	1	1	1	6	1	1	1
08498L0 Med det	13	1	1	1	13	1	1	1
14413DB Finance team	19	1	1	1	19	1	1	1
27512LD JAG team	5	1	1	1	5	1	1	1
43209L0 Maint co	200	1	2	2	200	1	1	2
435091G Wheel rep team	7	4	4	4	7	4	4	4
55540LE Trl trans pt	8	2	2	2	8	0	2	2
55728L1 Med trk co (cargo)	191	0	1	1	191	0	1	1
55728L1 Med trk co (water)	191	1	1	1	191	1	1	1
55728L2 Med trk co (petro)	177	1	2	2	177	1	1	2
55827L0 Tml svc	361	1	1	1	361	1	1	1
42419L0 Repair parts co	185	0	0	1				
Total space	1,584				1,207			

Since the rounding rule for the heavy truck company is 0.5 (round up at 0.5 or higher), and the allocation for the ACR and separate armored brigades is .167, our alternatives will never trigger the requirement for an additional heavy truck company unless the corps already contains at least two separate heavy brigade equivalents, and we assume an allocation of .167 for our alternatives.

(c) All of the study units in this analysis were run in FASTALS two ways. The first way was with the class VII requirement added and the second was without the class VII. Class VII was removed from the consumption tables for the study units in the basic analysis so it would not distort the requirement for medium truck companies. Some of the class VII would certainly be eligible for medium transport but the bulk would not, and therefore it was removed. The class VII is still a legitimate sustainment requirement; however, it affects the requirement for other types of service. The terminal service company (55827L) is included as a requirement in this analysis based on the class VII because the terminal servicing function for class VII is correct.

(d) The units determined to be support requirements in FASTALS for this analysis are allocated based on several factors. The first factor is those units based purely on population (which applies to the four units at the top of table G-9). The results for all of our

alternatives is the same for those personnel servicing type functions because our population increase is of the same general magnitude in all cases.

(e) The second major category of unit allocations is those units for which a workload can be generated and aggregated. The next two groups in our tables are of that type. The maintenance units are allocated on DS maintenance generated by the truck companies which are allocated based on the consumption, transportation, and handling requirements generated by the alternatives. A third category of allocation is those units allocated for C2 purposes. None of the alternatives in this analysis would have generated headquarters requirements in their own rights and therefore none were included.

(f) The ACRs and AIRCR have identical support requirements due to their fuel consumption. Their class III consumption generates a requirement for two truck companies which in turn generates a requirement for an additional DS maintenance company. That is the only significant difference between the ACR and AIRCR, and the MIB and LCR. The ACRs require an additional repair parts company. The results provided to TRAC-WSMR for costing are based on the moderate intensity rate because the other two extremes are unrealistic (all intense or all reserve) and because the rates provided by CASCOM and reported in this analysis for sustainment purposes are considered moderate rates. The alternatives show some sensitivity between moderate and intense consumption rates. The ACR and AIRCR are the least sensitive since their moderate rate produces the highest requirement among the alternatives.

(g) One area of expressed interest is in the sensitivity of the allocation of truck companies to haul water. The line haul capability of the medium truck company for water is 270,000 gallons per day. The per capita consumption of potable water within the regiments would have to exceed 80 gallons per person per day before additional transportation assets would be required. The SRA 96 SWA planning factor was 20 gallons per person per day.

e. *Sustainment requirements*. The total sustainment requirement, internal plus external, for the ACRs and each alternative can be computed now that their respective support slices have been determined. Table G-11 shows the total daily sustainment requirements by class of supply.

Table G-11. Total daily sustainment requirements
(STONs/day or gals/day)

Class	ACR	MACR	LCR	AIRCR	MIB
I *	22.19	22.03	20.14	20.04	21.74
II *	14.68	14.57	13.39	13.22	14.48
III +	94884	93510	65873	90653	63215
IV *	26.71	26.52	24.24	24.13	26.17
V +	190.4	216.3	134.74	111.43	177.7
VI *	10.68	10.61	9.70	9.65	10.47
VII +	423.5	414.99	297.24	108.12	139.4
VIII*	3.83	3.81	3.48	3.46	3.76
IX +	13.67	12.71	6.35	4.81	5.47
Water*	125700	124800	114080	113560	123160

* Population dependent + Equipment dependent

G-6. Comparison of alternatives.

a. *Discussion.* The ACRs are fundamentally different from the other alternatives. They are heavy, powerful, armored units in the true sense of that expression, designed to engage in intense combat with equally capable adversaries. The alternatives are more suited to the contingency reconnaissance and screening roles for which they were designed than for intense combat. The ACRs will be included, recognizing that they are not directly comparable. Table G-12 shows the required support quantities in four areas:

Table G-12. Summary of alternatives

	ACR	MACR	LCR	AIRCR	MIB
AMMH (thousands) (unit/AVUM & DS/AVIM)	2,419	2,190	1,712	2,391	1,574
GS Mechanics	88	65	32	29	32
Sustainment					
Class III (thousands gal/day)	95	94	66	91	63
Dry (STONs/day)	706	722	509	295	399
CSS Force	1,584	1,584	1,207	1,584	1,207

(1) Total internal (unit and DS) AMMH. Since the alternatives have generally the same number of people in them (approximately 5,000) a higher maintenance requirement means that more mechanics are required internal to the units and they therefore have a lower "tooth to tail" ratio.

(2) External (GS) mechanic requirement. The requirement for mechanics external to the units is a true additional cost. However, only the GS requirement has a force structure implication. How the GS requirement would be met depends upon the structure of the corps into which the alternatives would be deployed.

(3) Supply sustainment requirements. All other things being equal, the lower the average daily requirement, the easier the alternative is to support. This says nothing about combat effectiveness or efficiency which is outside the scope of this analysis. Sustainment is divided into dry commodities and class III.

(4) Supporting CSS force structure requirements. Similar to supply sustainment above, the smaller the support slice required, the easier the alternative is to support.

b. The MIB is the preferred alternative from a pure logistics standpoint. The LCR is rated second with the AIRCR rated third. The ACR and MACR are approximately the same and require the most logistics support.

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APPENDIX G

ANNEX I

LOGISTICS PROCESS

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Table G-I-1. ACR AMMH

MOS	Unit/AVUM	DS/AVIM	GS
13			
24	9,914		
27	240	23,546	4,720
29		8,610	
31	8,060		
33			
35		18,523	20,418
39		296	728
41		10,542	7,051
43	58	558	
44		1,554	178
45	87,092	108,285	46,354
52	29,549	19,536	12,305
62	24,566	7,895	1,180
63	714,709	274,867	182,522
67	505,160	93,540	
68	181,040	289,974	
76	408		
93	437	23	
Total	1,561,233	857,749	275,456

Table G-I-2. MACR AMMH

MOS	Unit/AVUM	DS/AVIM	GS
13			
24	9,914		
27	240	23,546	4,720
29		6,281	
31	5,854		
33			
35		1,993	2,189
39		107	302
41		2,500	1,982
43	59	558	
44		1,554	178
45	44,914	31,580	9,011
52	29,548	19,023	11,637
62	24,566	7,895	1,181
63	770,517	254,015	165,483
67	616,120	24,944	
68	201,480	112,248	
76	408		
93	437	23	
Total	1,704,057	486,267	196,683

Table G-I-3. AIRCR AMMH

MOS	Unit/AVUM	DS/AVIM	GS
13	17,824		
24	11,209		
27		6,904	3,712
29		319	18
31	216		
33	3,901	1,155	2,200
35		18,523	20,418
39		36	1,187
41		106	7,051
43	17	338	
44	588	90	37
45		3,872	151
52	20,102	10,414	7,040
62	27,814	9,048	1,061
63	362,100	105,045	76,985
67	1,089,160	68,596	
68	338,720	293,092	
76	962		
93	1,019	16	
Total	1,873,632	517,554	119,860

Table G-I-4. LCR AMMH

MOS	Unit/AVUM	DS/AVIM	GS
13	17,824		
24	11,209		
27		6,227	3,200
29		849	18
31	3,179		
33	3,901	1,155	2,200
35			
39		36	1,187
41		476	221
43	53	473	
44		22	22
45	52,864	3,742	514
52	11,913	5,700	4,305
62	17,821	6,056	1,352
63	487,815	115,824	83,929
67	624,880	24,944	
68	201,480	112,248	
76	530		
93	1,019	16	
Total	1,434,488	277,768	96,948

Table G-I-5. MIB AMMH

MOS	Unit/AVUM	DS/AVIM	GS
13	21,300		
24	11,209		
27		8,258	4,737
29		711	35
31	1,132		
33	3,901	1,155	2,200
35			31
39		588	1,195
41		399	156
43	53	472	
44		22	22
45	12,096	7,226	617
52	9,153	4,083	3,382
62	24,809	8,081	1,771
63	432,660	117,027	84,835
67	519,760	46,770	
68	148,920	190,198	
76	3,189		
93	1,119	16	
Total	1,189,301	385,006	98,981

Table G-I-6. ACR mechanic requirements

MOS	Unit/AVUM	DS/AVIM	GS
13	4		
24			
27		9	2
29		3	
31	3		
33			
35		7	7
39			
41		4	2
43			
44		1	
45	35	40	15
52	12	7	4
62	10	3	
63	293	102	58
67	173	30	
68	62	93	
76			
93			
Total	592	299	88

Table G-I-7. MACR mechanic requirements

MOS	Unit/AVUM	DS/AVIM	GS
13	4		
24			
27		9	2
29		2	
31	2		
33		1	1
35			
39			
41		1	1
43			
44		2	
45	18	13	4
52	12	7	4
62	10	3	
63	310	94	53
67	211	8	
68	69	36	
76			
93			
Total	636	176	65

Table G-I-8. AIRCR mechanic requirements

MOS	Unit/AVUM	DS/AVIM	GS
13	7		
24	4		
27		2	1
29			
31			
33	2		1
35			
39			
41			
43			
44			
45			
52	9	4	3
62	11	3	
63	145	39	24
67	373	22	
68	116	94	
76			
93			
Total	667	164	29

Table G-I-9. LCR mechanic requirements

MOS	Unit/AVUM	DS/AVIM	GS
13	7		
24	4		
27		2	1
29			
31	1		
33	2		1
35			
39			
41			
43			
44			
45	21		
52	5	3	2
62	7	2	
63	194	43	28
67	214	8	
68	69	36	
76			
93			
Total	524	94	32

Table G-I-10. MIB mechanic requirements

MOS	Unit/AVUM	DS/AVIM	GS
13	8		
24	4		
27		3	2
29			
31			
33	2		1
35			
39			
41			
43			
44			
45	5	2	
52	4	2	2
62	10	3	1
63	167	41	26
67	178	15	
68	51	61	
76	1		
93			
Total	430	127	32

Table G-I-11. AGMC planning factors (continued)

LIN	Cl III gal/day	Cl V lbs/day	Cl VII lbs/day	Cl IX lbs/day
Z06764	(A93125) 26.2	(T13169) 160.02	(A93125) 3006	(A93125) 26.63
02221 (T92242)	5.61	9.75	118.42	1.56
002226 (T92242)	5.61	9.75	118.42	1.56
Z33524 (K29694)	241.56	69.61	217.85	6.67
K32293	438.50	-	207.40	13.23
H30616	438.50	-	256.75	12.18
G68966	-	-	-	-
Z28175	(T92242) 5.61	No rate	558.00	(T92242) 1.56
Q53301	-	-	.61	.02
Z77248	(T92242) 5.61	No rate	(T61494) 45.94	(T92242 1.56
Z13098	-	(E56896) 52.69	No rate	No rate
Z15752	-	(E56896) 52.69	No rate	No rate
Z62820 (A30585)	279.0	-	70.00	1.28
T92242	5.61	9.75	118.42	1.56
T61494	6.41	-	45.94	1.56
T38844	6.41	-	39.88	(T61494) 1.56
M02114	-	897.89	7.47	.28
Z13322 (M68282)	-	1861.43	8.94	.27

Table G-I-11. AGMC planning factors (continued)

LIN	Cl III gal/day	Cl V lbs/day	Cl VII lbs/day	Cl IX lbs/day
D10741	5.95	-	1663.3	23.40
K57803	-	12096	568	(K57821) 125
K57821	-	12096	713	125
R95387	-	.19	.11	(M09009) .01
M09009	-	3.58	.19	.01
L44575	-	2.07	.06	(M09009) .01
X40009	15.62	-	84.35	2.34
X40831	19.10	-	138.01	6.39
X43708	17.78	-	187.96	4.93
X40794	17.96	-	134.28	6.39
W95537	-	-	9.65	.02
W95811	-	-	54.83	.04
W94030	-	-	95.01	.04
W94441	-	-	86.44	.04
T45465	-	-	99.00	.19
S70661	-	-	171.07	2.67
W98825	-	-	16.72	.03
Y48323	-	-	11.8	0
L28351	-	-	28.84	.07
T58161	38.51	-	257.16	4.45
T59278	38.74	-	248.32	(T58161) 4.45
T63093 (T58161)	38.51	-	257.16	4.45

Table G-I-11. AGMC planning factors (continued)

LIN	Cl III gal/day	Cl V lbs/day	Cl VII lbs/day	Cl IX lbs/day
T61035	26.43	-	194.99	9.84
X59326	17.83	-	126.02	9.73
S70243	-	-	126.00	1.50
S70027	-	-	84.08	1.00
X62340	14.13	-	102.44	3.50
X62081	14.51	-	141.58	(X60696) 7.51
X60696	18.74		213.41	7.51
V19950	-	-	4.35	No rate
S73372	-	-	86.72	1.17
W76473	178.91	-	291.10	13.90
T34437	100.00	-	55.90	3.11
D11049	15.47	10.22	95.26	33.36
D30897	-	No rate	(D20529) 12.15	No rate
L67342	-	No rate	(W94030) 209.5	(W94030) .04
Z11216	-	-	213.94	0
V12141	5.40	-	18.29	0
Z32417 (T61494)	6.41	-	45.94	1.56
P44377	72.00	-	1.54	0
B71632	-	-	115.82	0
T07543	5.61	-	43.86	0
D82404	84	-	1.58	.16
G51840	-	-	No rate	No rate

Table G-I-11. AGMC planning factors (concluded)

LIN	Cl III gal/day	Cl V lbs/day	Cl VII lbs/day	Cl IX lbs/day
P91756	6	-	.55	No rate
C10858	151.99	-	416.23	8.22
H01907	-	-	28.37	No rate
H01912	-	-	21.67	No rate
Z93507	(T61035) 26.43	-	248.32 .19	(T61035) 9.84
Z90473	-	-	108.00	(S70234) 1.50
T10138	72.89	-	42.78	(T38844) 1.56
J35835	29.10	-	27.83	.50
J36725	60.00	-	16.23	.22
J38301	120.00	-	20.10	1.06
T49119	23.8	-	174.31	7.45
T49096	25.0	-	52.39	(T49255) 2.17
T49255	14.82	-	48.50	2.17
T59278	38.74	-	248.32	No rate
H01855	-	-	115.78	No rate
T25619	-	-	51.63	No rate
F43003	100.00	-	133.74	1.33
A41666	-	-	91.39	1.00

G-I-1. Materiel process. The basic information that is passed to the transportation module of FASTALS is the requirement for resupply of the 12 supply categories played in the model at each geographical location in the theater. A FASTALS theater is divided into physical and logical regions that correspond to division, corps, RCZ, COMMZ, ports, and off-shore areas. The SRA 96 SWA theater had 13 physical regions with 4 regions each representing the division and corps areas. For each region, stockage policies expressed in days of supply are input into the model. Since there were no prepositioned stocks in this theater, stockages had

to be established after the beginning of the theater population buildup. Resupply requirements are determined in the following manner:

a. Compute daily consumption of each class of supply in each region for each time period (SRA 96 had seven 10-day time periods).

b. Apply the stated stockage policy for each class in each time period to determine the gross requirements of materiel.

c. Compute the differences of gross requirements between successive time periods to obtain net resupply requirements of each category in each region for each time period. A negative requirement is interpreted as an excess in a given region during the time period in which it occurs. The transportation module will use this excess if a region that is forward of the overstocked region has a positive requirement and a path has been drawn to allow the movement from the overstocked region.

G-I-2. Transportation process. Once the resupply requirements have been determined, the transportation module will allocate resources to move them subject to the constraints of the transportation system. This requires two types of information.

a. *Network description.* The SRA 96 SWA scenario contains a stylized transportation network consisting of predetermined paths going from physical region to physical region. The paths are made up of links of different modes (highway, rail, intratheater air, etc.) with different lengths and capacities.

b. *Mode preferences.* Each category of supply played in the model has a preferred transportation mode. These preferences are input by percentage, priority, and region. For example, the preferred mode for shipping ammunition destined for the division area might be 60 percent highway and 40 percent rail. If the capacity of the network cannot meet the requirement, the preference defaults to a second and third mode category combination until the requirement can be met. The workload that the force structure will be allocated against is based upon the mode preferences that meet the requirements. Inability of the system to satisfy any mode preferences results in error messages and the supply category being shipped by the first preference. The model may allocate engineer units to upgrade saturated links during the simulation if the data indicates that they can be upgraded.

G-I-3. Computation of workloads. Once resupply requirements and a satisfactory mode preference combination have been determined, a transportation workload is computed. The primary workload affecting transportation units in this analysis relates to truck transportation. Medium truck companies are allocated for various types of commodities (dry cargo, POL, water) based on ton-hours for line haul and tons consumed for local haul. In FASTALS all commodities are calculated on a pounds per man per day basis and aggregated into tons. A ton-hour represents a ton of supply being moved for one hour. It considers weight, distance,

and rate. Through an approximation, it also considers load/unload time (1 hour load, 1 hour unload). The computation is:

$$\text{STON-hours per day} = \frac{6DT}{5RL}$$

where D = round trip distance of link in miles,
T = STON's per day hauled on the link, and
RL = the rate, in miles per hour, which is applied to links having an origin in logical region L.

G-I-4. Allocation of medium truck companies. Once FASTALS has computed ton-hour workloads, they must be converted into force structure. The capability of a medium truck company as represented in FASTALS is based on:

No. of trucks * % availability * capacity * operating hours

for line haul, and

No. of trucks * % availability * capacity * no. of trips/day

for local haul. The 55728L series medium truck companies have 60 trucks at 75 percent availability and varying capacities depending upon whether they transport dry cargo, fuel, or water. The capacities are:

Dry cargo: 15 tons

Fuel: 5,000 gallons

Water: 3,000 gallons

G-I-5. Allocation of maintenance units. Maintenance units are allocated in FASTALS based on the number of maintenance manhours the unit can satisfy per day. This calculation is:

no. of mechanics * productive manhours/mechanic/day

The accumulation of maintenance workloads for units is described in the next paragraph on representation of study units in the model.

G-I-6. Representation of study units in FASTALS. In order to represent the ACR and the three alternative regiments in the model, they must be described in terms that FASTALS can use to generate requirements. That information consists of:

a. *Unit weight.* Terminal service units and some transportation units are based on receiving and processing unit equipment into the theater.

b. *Unit strength.* Many personnel service type units (finance, medical, clerical, legal, etc.), and the total calculation of consumption is based on unit strength.

c. *Consumption characteristics.* Combat units consume according to their combat posture and noncombat units consume at a constant rate based on a theater average for each class of supply. Since the ACR and alternative regiments are combat units, the sustainment rates determined in the supply impacts portion of this report will be converted into pounds per man per day and put into the model. The rates that CASCOM provides are considered to be of moderate intensity. A constant relationship exists in FASTALS between the moderate rate and the intense, reduced, and reserve rates. The ratio of intense, reduced, and reserve to moderate is 1.4/0.6/0.3 with 1.0 being moderate.

d. *Maintenance requirements.* The manhours determined in the maintenance impact portion of the report will be input based on certain maintenance skills called leader MOSs. Different types of maintenance units will be allocated within the theater, if necessary, to satisfy those AMMH requirements. Table G-I-12 shows the leader MOS breakdown by type maintenance. Each description in table G-I-12 is used to generate a separate type of maintenance workload for different kinds of maintenance units and teams.

G-I-7. Unit entries in FASTALS. Tables G-I-13 through G-I-17 show the data used for the ACR and each alternative in FASTALS.

Table G-I-12. FASTALS MOS breakdown

Level	Description	MOS
GS	Radar	39C
DS	Auto	63W
GS	Auto	63H
		63W
GS	FC Inst	41C
GS	FC Sys	45G
GS	Artillery	45L
DS	Turb eng	52F
DS	Commel	29E
		29J
		29N
		39D
		39E
GS	Comsec	29S
GS	Commel	29E
		29J
		29M
		29N
		36L
		39E
GS	Sigint/ew	33T
GS	Power gen	52D
GS	Turb eng	52F

Table G-I-13. FASTALS entry

Unit	AIRCR
Weight	9210
Strength	4094
Consumption (moderate)	
III	120.48
V	52.67
VII	40.01
IX	1.84
Maintenance (mmh per day)	
GS radar	.41
DS auto	266.6
GS auto	220.4
GS FC sys	
GS arty	
DS commel	.89
GS commel	.05
GS sigint	
GS pwr gen	14.9

Table G-I-14. FASTALS entry

Unit	LCR
Weight	11314
Strength	4497
Consumption (moderate)	
III	78.57
V	58.77
VII	123.31
IX	2.47
Maintenance (mmh per day)	
GS radar	.41
DS auto	286.5
GS auto	222.1
GS FC sys	.61
GS arty	.93
DS commel	2.34
GS commel	.05
GS sigint	1.7
GS pwr gen	7.4

Table G-I-15. FASTALS entry

Unit	MIB
Weight	9818
Strength	4951
Consumption (moderate)	
III	67.74
V	70.67
VII	53.97
IX	1.97
Maintenance (mmh per day)	
GS radar	.42
DS auto	293.6
GS auto	224.5
GS FC sys	.43
GS arty	
DS commel	1.97
GS commel	.096
GS sigint	1.7
GS pwr gen	4.86

Table G-I-16. FASTALS entry

Unit	ACR
Weight	22687
Strength	4701
Consumption (moderate)	
III	111.25
V	79.46
VII	169.0
IX	5.37
Maintenance (mmh per day)	
GS radar	
DS auto	269.0
GS auto	487.4
GS FC inst	19.32
GS arty	14.66
DS commel	24.27
GS commel	1.52
GS sigint	
GS pwr gen	21.6

Table G-I-17. FASTALS entry

Unit	MACR
Weight	22629
Strength	4656
Consumption	
III	110.25
V	91.37
VII	167.00
IX	5.01
Maintenance (mmh per day)	
GS radar	.09
DS auto	269.0
GS auto	2212.0
GS FC inst	5.4
GS arty	9.14
DS commel	17.26
GS commel	.16
GS sigint	
GS pwr gen	27.0

APPENDIX H

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APPENDIX H

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